Year 1 Monitoring Report

for

Site 23 Underdrain Metering Pit Sampling

Naval Submarine Base
New London

Groton, Connecticut

Naval Facilities Engineering Command
Mid-Atlantic

Contract Number N62472-03-D-0057

Contract Task Order 73

September 2008

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YEAR 1 MONITORING REPORT
FOR
SITE 23 - UNDERDRAIN METERING PIT

NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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ACRONYMS

%C	Percent completeness
%R	Percent recovery
AS/SVE	Air sparging/soil vapor extraction
AST	above-ground storage tank
BGOURI	Basewide Groundwater Operable Unit Remedial Investigation Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CTDEP	Connecticut Department of Environmental Protection
CTO	Contract Task Order
DERP	Defense Environmental Restoration Program
DQI	Data quality indicator
DO	Dissolved oxygen
ETPH	Extractable total petroleum hydrocarbons
FWEC	Foster Wheeler Environmental Corporation
HDPE	High-density polyethylene
HHRA	Human Health Risk Assessment
IRP	Installation Restoration Program
LCS	Laboratory control sample
LCSD	LCS duplicate
MDL	Method detection limit
µg/L	Microgram per liter
mg/L	Milligram per liter
mS/cm	MilliSiemen per centimeter
MS/MSD	Matrix spike/matrix spike duplicate
Navy	United States Department of the Navy
NEX	Naval Exchange
NSB-NLON	Naval Submarine Base-New London
NTU	Nephelometric turbidity unit
ORP	Oxidation-reduction potential
OU	Operable Unit
PAH	Polynuclear aromatic hydrocarbon
PCMP	Perforated corrugated metal pipe
PQL	Practical quantitative limit
PVC	Polyvinyl chloride

QA/QC	Quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RPD	Relative percent difference
RSR	Remediation Standard Regulations
SARA	Superfund Amendments and Reauthorization Act
SVOC	Semivolatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
Tetra Tech	Tetra Tech NUS, Inc.
TPH	Total petroleum hydrocarbons
TSS	Total suspended solids
USEPA	United States Environmental Protection Agency
UST	Underground storage tank
VOC	Volatile organic compound

1.0 INTRODUCTION

1.1 PURPOSE

This Year 1 Monitoring Report summarizes the field activities, analytical results, and data evaluations for underdrain metering pit sampling at Site 23 (Tank Farm) at Naval Submarine Base-New London (NSB-NLON) in Groton, Connecticut. This work was conducted by Tetra Tech NUS, Inc. (Tetra Tech) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract N62472-03-D-0057, Contract Task Order (CTO) 073. The work is part of the United States Department of the Navy's (Navy) Installation Restoration Program (IRP), a component of the Defense Environmental Restoration Program (DERP) established under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA).

1.2 OBJECTIVES

The objective of the field work was to collect four quarterly rounds of water samples from the metering pit located just before the groundwater underdrain system connects with the storm sewer system, which then carries the combined flow to the Thames River outfall. The objective of this report is to summarize the results of the four quarterly sampling events conducted between June 2007 and February 2008 and to determine if the quality of groundwater conveyed by the underdrain piping poses potential risks to human health or the environment.

1.3 FACILITY LOCATION AND DESCRIPTION

NSB-NLON is located in southern Connecticut in the Towns of Ledyard and Groton. NSB-NLON is situated on the eastern bank of the Thames River, approximately 6 miles north of Long Island Sound. It is bordered on the east by Connecticut Route 12, on the south by Crystal Lake Road, and on the west by the Thames River. The northern border is a low ridge that trends approximately east-southeastward from the Thames River to Baldwin Hill. A general facility location map is presented as Figure 1-1. The location of each IRP site within NSB-NLON is shown on Figure 1-2.

1.4 SITE LOCATION AND DESCRIPTION

Site 23 is located between Tang Avenue and Crystal Lake Road in the southern portion of NSB-NLON. The general configuration of Site 23 is shown on Figure 1-3.

The Tank Farm features nine former underground storage tanks (UST) that were demolished and closed in place, a 30,000-gallon, double-walled UST (OT-10), a former oil/water separator, a 10,000-gallon waste oil tank, a fuel oil loading area, a tanker truck dumping pad and trough, associated UST piping systems, baseball/softball fields, buildings that housed the former air sparging/soil vapor extraction (AS/SVE) facility for the Naval Exchange (NEX) service station, two 150,000-gallon diesel above-ground storage tank (ASTs), and other buildings. The soil at Site 23 was investigated and remediated under the Connecticut Department of Environmental Protection (CTDEP) Resource Conservation and Recovery Act (RCRA) UST Program. Groundwater associated with the site is being investigated under CERCLA (TtNUS, 2006) and is considered part of Operable Unit (OU) 9.

The Tank Farm originally contained an extensive drainage system consisting of numerous catch basins, corrugated metal pipe, perforated corrugated metal pipe (PCMP), vitrified clay pipe, and reinforced concrete pipe. Portions of the drainage system were installed with PCMP to depress the water table in the Tank Farm to prevent groundwater from exerting uplift forces on the bottoms of the tanks. Both surface water and groundwater collected by the piping systems ultimately flow to the storm drain system near the Main Gate and are discharged to a boomed area of the Thames River, adjacent to the Goss Cove Landfill.

The drainage system was rehabilitated in 2000. The original combined groundwater and stormwater system was separated into a deep groundwater and a new shallow stormwater system. The groundwater underdrain collects water from the old tank ring drains (french drains). Over 2,000 feet of old deteriorated pipes in the groundwater underdrain system connecting the ring drains to the storm sewer were slip-lined to improve their integrity and conductance. A portion of the refurbished piping is shown by a dashed line on Figure 1-4. An existing manhole, initially intended to be converted into an oil/water separator, was modified to become a groundwater flow-metering pit. In the manhole, a 18-inch-diameter high-density polyethylene (HDPE) slip line was cut in half longitudinally to form a trough that could be used to meter flow. The annular space between the HDPE slip line and the old pipe was bricked and grouted with a watertight material, and the base of the structure was filled with grout to the top of the trough. Under this construction, all of the groundwater entering the metering pit flows through the trough, and the quantity of flow can be measured. The depth of the metering pit is approximately 15 feet. Field sketch FSK-003 of this structure is presented as Figure 1-5 (FWEC, 2001).

After completion of the storm sewer rehabilitation project, flow measurements were taken in the metering pit from October 4, 2000 to December 8, 2000. Daily flow rates ranged from 75,000 gallons per day (October 5, 2000) to 122,000 gallons per day (December 2, 2000). In addition, seven groundwater samples were collected from the metering pit between July 25, 2000 and May 23, 2001 and analyzed for a varying list of analytical parameters including fuel type fingerprint (Method 8015), pH (Method EPA 150.1), total petroleum hydrocarbons (TPH) (Method 418.1), oil and grease (Method EPA 413.1), total suspended solids (TSS) (Method 160.2), inorganics (Method 6010B), volatile organic compounds (VOC)

(Method OLM2.1), semivolatile organic compounds (SVOCs) (Method 8270C), and polynuclear aromatic hydrocarbons (PAHs) (Method 8310). The analytical results varied per round, and no official evaluation of data compared to Connecticut criteria was completed, but in general the results did not indicate that there were significant concentrations of contaminants typically found in fuel oil present in the groundwater.

1.5 REPORT FORMAT

Section 1.0 of the report is this brief introduction. Section 2.0 describes the field tasks and methodologies in detail. Section 3.0 summarizes and evaluates the data collected during the Year 1 program. Conclusions and recommendations are provided in Section 4.0. Field forms (Appendix A), the Round 4 Data Validation Letter (Appendix B), analytical database (Appendix C), and human health risk assessment memoranda (Appendices D and E) are provided as appendices to this report.

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0 2000 4000
GRAPHIC SCALE IN FEET

SOURCE: USGS QUADRANGLE MAP UNCASVILLE, CONNECTICUT, 1984

DRAWN BY	DATE
DT	4/25/07
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	

Tetra Tech NUS, Inc.

FACILITY LOCATION MAP
NSB–NLON
GROTON, CONNECTICUT

CONTRACT NO. 0777	
OWNER NO. 073	
APPROVED BY CAR	DATE 9/4/08
DRAWING NO. FIGURE 1–1	REV. 0

FORM CADD NO. TTNUS-AV.DWG - REV 1 -9/10/98

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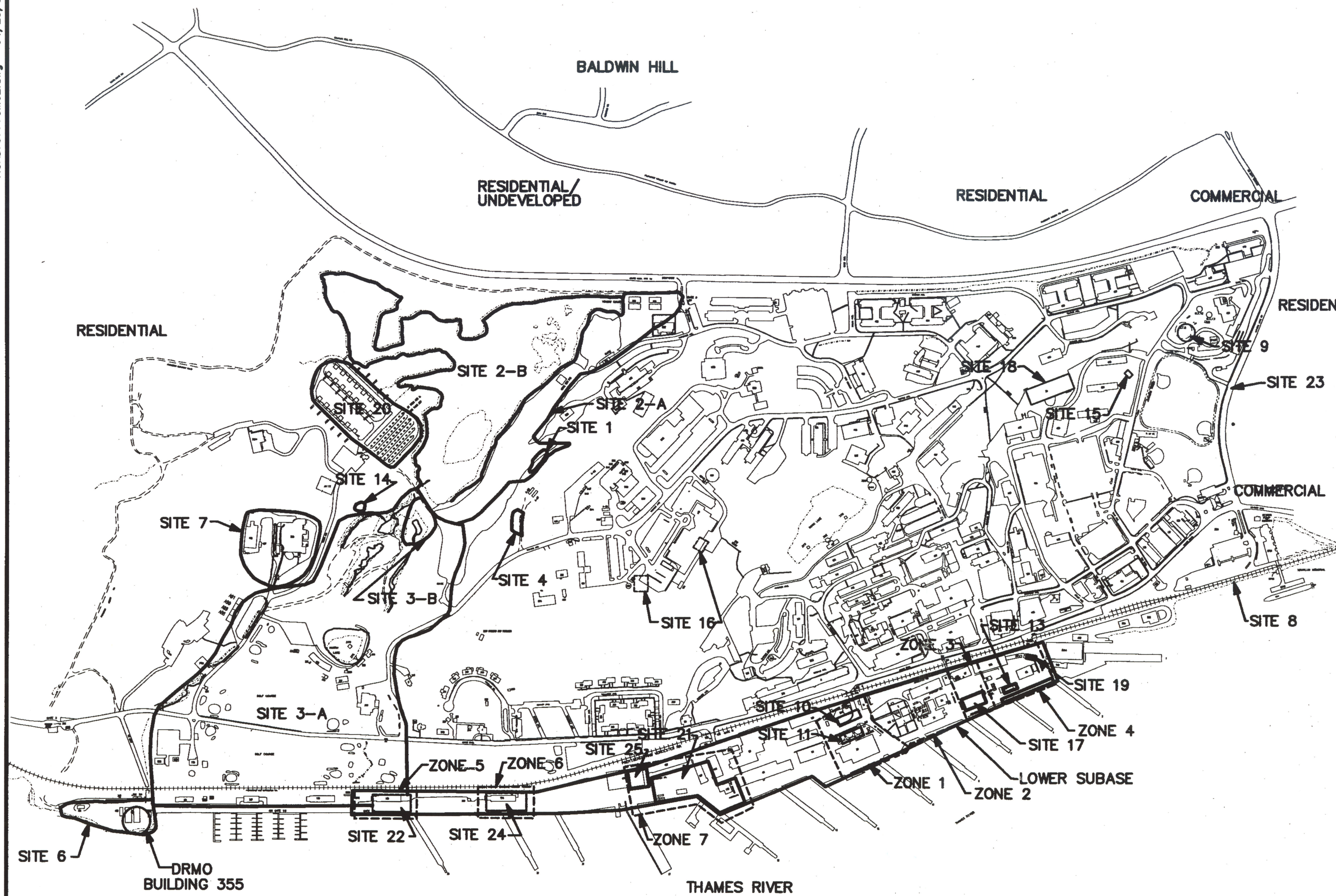

N

NOTES:

1. SITE AND STUDY AREA LOCATIONS WERE TAKEN FROM THE FOLLOWING REPORTS:
   - FEDERAL FACILITY AGREEMENT UNDER CERCLA 120, NAVAL SUBMARINE BASE, NEW LONDON, CONNECTICUT
   - FINAL INITIAL ASSESSMENT STUDY (ENVIRODYNE, MARCH 1983)
   - HYDROGEOLOGIC INVESTIGATION UNDERGROUND STORAGE TANKS OT-4, OT-7, OT-8, OT-9, AND 54-H (FUSS & O'NEILL, SEPTEMBER 1989)
   - PHASE I REMEDIAL INVESTIGATION (ATLANTIC, AUGUST 1992)
   - SITE CHARACTERIZATION REPORT FOR OT-10, BUILDING 325, AND BUILDING 89 (HNUS, APRIL 1995)
   - DRAFT FINAL SUPPLEMENT TO INITIAL ASSESSMENT STUDY (NAVAL FACILITIES ENGINEERING SERVICE CENTER, APRIL 1995)
   - REMOVAL SITE EVALUATION FOR QUAY WALL (HNUS, MAY 1995)
2. SITE AND STUDY AREA BOUNDRIES ARE APPROXIMATE.

SITE 1 – CONSTRUCTION BATTALION UNIT (CBU) DRUM STORAGE AREA
SITE 2 – (A) AREA A LANDFILL AND (B) AREA A WETLAND
SITE 3 – (A) AREA A DOWNSTREAM WATER COURSES AND (B) OVERBANK DISPOSAL AREA (OBDA)
SITE 4 – RUBBLE FILL AREA AT BUNKER A-86
SITE 6 – DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO)
SITE 7 – TORPEDO SHOPS
SITE 8 – GOSS COVE LANDFILL
SITE 9 – OILY WASTEWATER TANK (OT-5)
SITE 10 – LOWER SUBASE-FUEL STORAGE TANKS AND TANK 54-H
SITE 11 – LOWER SUBASE-POWER PLANT OIL TANKS
SITE 13 – LOWER SUBASE-BUILDING 79 WASTE OIL PIT
SITE 14 – OVERBANK DISPOSAL AREA NORTHEAST (OBDANE)
SITE 15 – SPENT ACID STORAGE AND DISPOSAL AREA (SASDA)
SITE 16 – HOSPITAL INCINERATORS
SITE 17 – HAZARDOUS MATERIALS/SOLVENT STORAGE AREA (BUILDING 31)
SITE 18 – SOLVENT STORAGE AREA (BUILDING 33)
SITE 19 – SOLVENT STORAGE AREA (BUILDING 316)
SITE 20 – AREA A WEAPONS CENTER
SITE 21 – BERTH 16
SITE 22 – PIER 33
SITE 23 – FUEL FARM
SITE 24 – CENTRAL PAINT ACCUMULATION AREA (BUILDING 174)
SITE 25 – LOWER SUBASE-CLASSIFIED MATERIALS INCINERATOR

0 800 1600
GRAPHIC SCALE IN FEET

BASE MAP SOURCE: PREPARED BY THE NAVAL SUBMARINE BASE PUBLIC WORKS DEPT., ENGINEERING DIVISION. MARCH 2006, DRAWING NO. A-667.

DRAWN BY DT	DATE 4/25/07	Tetra Tech NUS, Inc.	SITE LOCATION MAP NSB-NLON GROTON, CONNECTICUT	CONTRACT NO. 0777	
CHECKED BY NJB	DATE 4/27/07			OWNER NO. 073	
REVISED BY	DATE			APPROVED BY CAL	DATE 4/27/07
SCALE AS NOTED				DRAWING NO. FIGURE 1-2	REV. 0

FORM CADD NO. TTNUS-BH.DWG - REV 1 - 9/10/98

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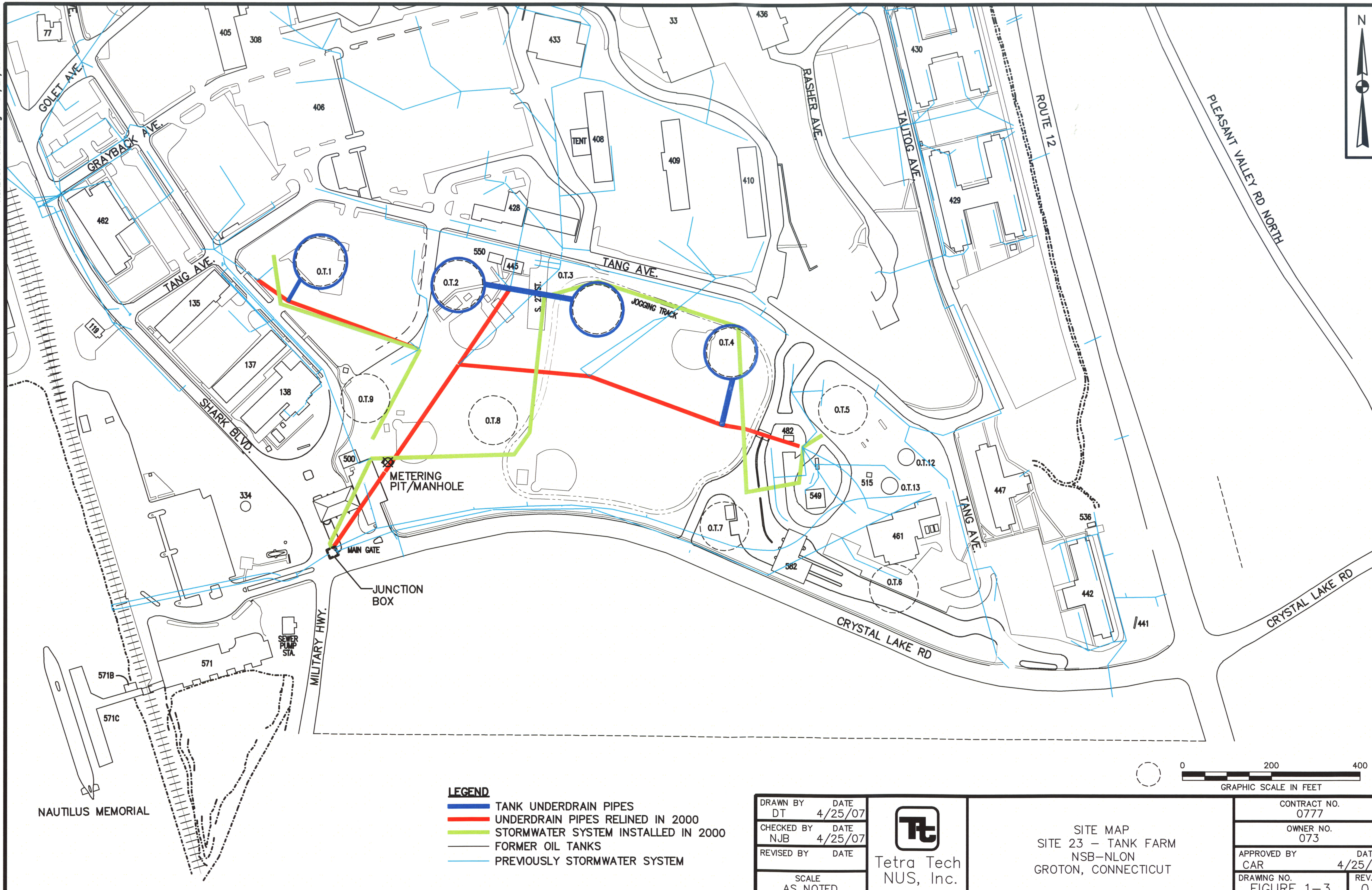

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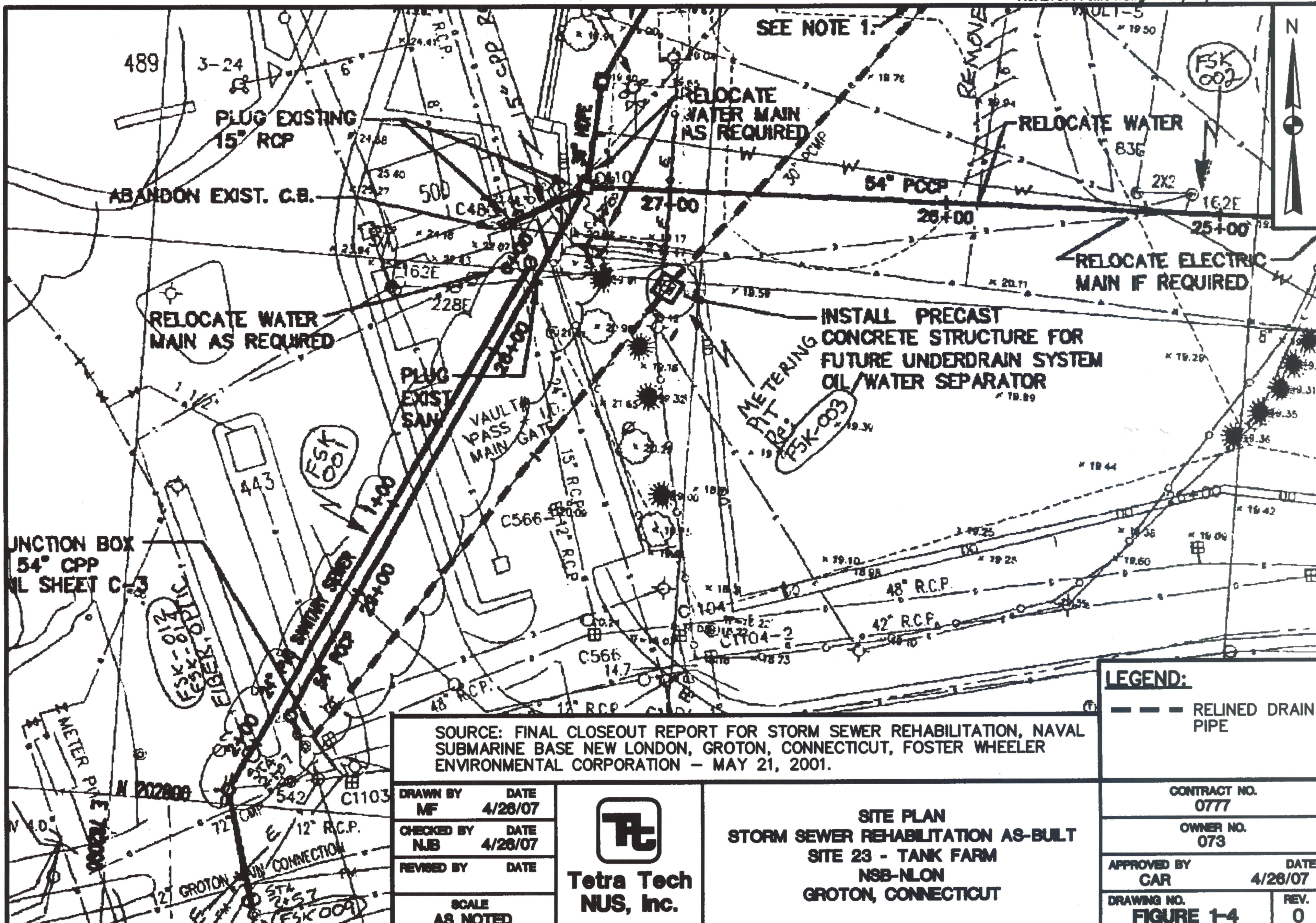

SOURCE: FINAL CLOSEOUT REPORT FOR STORM SEWER REHABILITATION, NAVAL SUBMARINE BASE NEW LONDON, GROTON, CONNECTICUT, FOSTER WHEELER ENVIRONMENTAL CORPORATION – MAY 21, 2001.

LEGEND:

— — — RELINED DRAIN PIPE

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CHECKED BY NJB, DATE 4/26/07			OWNER NO. 073
REVISED BY, DATE			APPROVED BY CAR, DATE 4/26/07
SCALE AS NOTED			DRAWING NO. FIGURE 1-4, REV. 0

FORM CADD NO. TTNUS-AH.DWG - REV 1 -9/10/98

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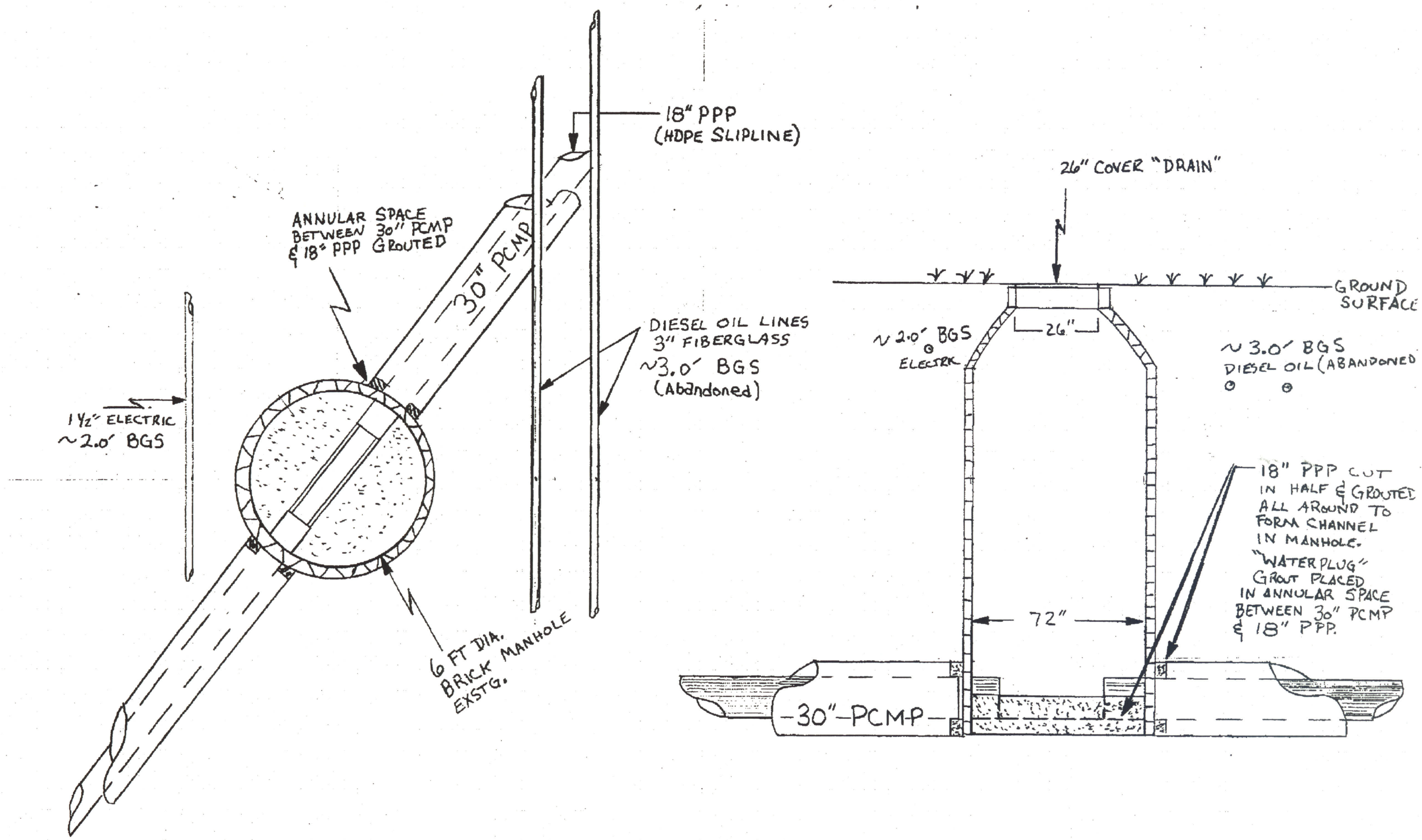

SOURCE: FINAL CLOSEOUT REPORT FOR STORM SEWER REHABILITATION, NAVAL SUBMARINE BASE NEW LONDON, GROTON, CONNECTICUT, FOSTER WHEELER ENVIRONMENTAL CORPORATION – MAY 21, 2001.

DRAWN BY: MF — DATE: 4/26/07 CHECKED BY: NJB — DATE: 4/26/07 REVISED BY — DATE SCALE: AS NOTED	Tetra Tech NUS, Inc.	METERING PIT - AS-BUILT FIELD SKETCH FSK-003 SITE 23 - TANK FARM NSB-NLON GROTON, CONNECTICUT	CONTRACT NO. 0777 OWNER NO. 073 APPROVED BY: CAR — DATE: 4/26/07 DRAWING NO. FIGURE 1-5 — REV. 0

FORM CADD NO. TTNUS-BH.DWG – REV 1 – 9/10/98

2.0 FIELD WORK

Four rounds of sampling were conducted during Year 1 in accordance with the Work Plan for Site 23 Underdrain Metering Pit Sampling (Tetra Tech, 2007a). The dates of the sampling rounds are as follows:

- Round 1 – June 18, 2007
- Round 2 – September 6, 2007
- Round 3 – December 18, 2007
- Round 4 – February 21, 2008

The field work performed during the four rounds of sampling is described in the following sections.

2.1 SAMPLE COLLECTION

General field activities performed during the sampling rounds included removing the manhole cover, collecting samples from the underdrain metering pit, collecting quality assurance/quality control (QA/QC) samples, and measuring water quality parameters. The field forms associated with the Round 4 sampling effort (i.e., copies of the relevant field logbook pages, chain of custody forms, sample log sheets, and equipment calibration logs) are included in Appendix A. The field forms for Rounds 1 through 3 were previously provided in the round-specific letter reports (Tetra Tech, 2007b, 2007c, and 2008).

During Rounds 1 through 3, sampling was completed by lowering a dedicated stainless steel beaker into the manhole along the centerline of the bottom of the metering pit at a 45-degree angle, with the mouth of the beaker facing upstream. The beaker was allowed to fill, and the sample was then retrieved and transferred to the appropriate sample containers.

During Round 4, a new sampling technique was implemented in an attempt to minimize incorporation of suspended solids and iron floc into the samples. The need for the new technique was identified in the Round 3 Letter Report (Tetra Tech, 2008), and the new technique included the following steps:

- Installation of polyvinyl chloride (PVC) riser with an attached 2-foot length of screen with a slot size of 0.01 inch into the flow in the Site 23 underdrain metering pit.

- Insertion of Teflon tubing inside the PVC riser until the end of the tubing was approximately 2 inches off the bottom of the underdrain metering pit. Water in the pit was approximately 3 to 4 inches in depth.

- Use of surgical-grade silicone tubing to connect the Teflon tubing to a peristaltic pump. Purging of several hundred milliliters of water through the tubing until the water appeared clear (i.e., low turbidity).

- Adjustment of the pump rate to 200 milliliters per minute and filling of appropriate sample containers, collecting unfiltered parameters first and then dissolved parameters. A 0.45-micron in-line filter was used to filter the samples in the field. Per the recommendation provided in the Round 3 Letter Report, total and dissolved (filtered) samples were collected for PAHs and Extractable Total Petroleum Hydrocarbon (ETPH) analysis during Round 4 to evaluate the potential impact of suspended solids and/or iron floc on the analytical results.

All samples were placed on ice immediately after collection and then sent to the laboratory for analysis.

2.2 WATER QUALITY

A summary of the water quality measurements collected during the four rounds of sampling is provided in Table 2-1. The parameters that were measured and are summarized in Table 2-1 include pH, conductivity, dissolved oxygen (DO), temperature, oxidation-reduction potential (ORP), and turbidity. With a few exceptions, most of the measurements were consistent over the four rounds of measurements or varied as expected based on seasonal changes. One exception was the high conductivity measurement [5.8 milliSiemens per centimeter (mS/cm)] recorded during Round 2, which appears to be anomalous when compared to the other three rounds of data. The equipment calibration results, field notes, and manufacturer's information for the water quality probe were reviewed; however, a cause for the anomaly could not be determined. Another exception is the high DO concentration (18.26 mg/L) recorded during Round 4. It is likely that this artificially high concentration is related to oxygen being incorporated into the sample by the sampling technique (i.e., peristaltic pump) used during Round 4. The last exception is turbidity, which consistently declined over the four sampling rounds. It appears that the sampling technique steadily improved during the first three rounds of sampling, with turbidity readings decreasing from 55.6 nephelometric turbidity units (NTUs) to 3.4 NTUs. The new sampling approach used during Round 4 resulted in the lowest turbidity (2.43 NTUs) of any of the rounds and is expected to have resulted in sample results with the least impact from turbidity.

2.3 ANALYTICAL PROGRAM

After collection, the samples were packaged and shipped to the project laboratory, Katahdin Analytical Services in Scarborough, Maine, for analysis. The samples were analyzed by the laboratory for Target Compound List (TCL) VOCs, TCL SVOCs, TCL PAHs, Target Analyte List (TAL) metals (total and dissolved), oil and grease, and ETPH per the Work Plan. Per the recommendation provided in the

Round 3 Letter Report, filtered samples were also analyzed for PAHs and ETPH during Round 4 to evaluate the potential impact of suspended solids and/or iron floc on the analytical results.

2.4 QA/QC PROGRAM

Samples collected to meet QA/QC requirements included in the Work Plan were trip blanks, field duplicates, and matrix spike/matrix spike duplicate (MS/MSD). The blanks and duplicates collected and submitted during each round were identified on the chain-of-custody forms and sample log sheets. Trip blanks were included in the coolers shipped to the laboratory during Rounds 1 through 4 that contained samples for TCL VOC analysis. Trip blanks are used to assess the potential for contamination of samples to be analyzed for VOCs by contaminant migration into sample containers during sample shipment and storage. Field duplicates were collected during Rounds 1 and 3, in accordance with the Work Plan, to help identify the precision of the sampling and analysis procedures. MS/MSD samples were collected and sent to the laboratory during each round of sampling to help identify method performance and precision issues.

2.5 DECONTAMINATION

Minimal decontamination efforts were required during the field sampling program. The beaker used to collect samples during Rounds 1 through 3 was decontaminated prior to and after sampling using a potable water rinse, detergent rinse, and potable water rinse. The small quantity of decontamination fluid generated during decontamination was directly disposed into the sanitary sewer system. The Teflon tubing used to collect the water sample during Round 4 did not require decontamination. The tubing was retained to be used for additional sampling of the metering pit if required in the future. During all rounds, purge water generated during sampling was returned to the Site 23 underdrain metering pit.

TABLE 2-1

SUMMARY OF WATER QUALITY MEASUREMENTS
ROUNDS 1 THROUGH 4 SAMPLING EVENTS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Round	pH (SU)	Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	Temperature (ºC)	Oxidation-Reduction Potential (mV)	Turbidity (NTU)
1	6.18	0.709	9.00	16.63	45	55.60
2	6.61	5.8(1)	4.70	17.30	15	26.00
3	5.67	0.594	4.15	13.20	52	3.40
4	6.33	0.648	18.26(2)	11.76	40	2.43

1 Result appears to be anomalous compared to the other three rounds of data. The equipment calibration results, field notes, and manufacturer's information for the water quality probe were reviewed; however, a cause for the anomaly could not be determined.

2 Result appears to be anomalous compared to the other three rounds of data. The peristaltic pump used during Round 4 may have caused this elevated dissolved oxygen concentration.

3.0 RESULTS

3.1 DATA VALIDATION

This section describes the data review processes used to determine whether analytical laboratory data were of acceptable technical quality for use in decision making. The review began with data validation, which is a comparison of data quality indicators (DQIs) to prescribed acceptance criteria. The DQIs are measures to assess the bias and precision of the analytical calibrations and sample analyses. The output of this review was a set of alphabetic flags such as ”U,” “J,” “R,” or combinations thereof, that may have been assigned to individual results based on the validation effort. These flags were used to infer the general quality of the data. Also evaluated were the measures of data completeness, sensitivity, comparability, and representativeness.

3.1.1 Data Validation Process

All of the results from analytical laboratory samples were validated according to several specifications. Assignment of data qualification flags conformed to United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for Low Concentration Organic Data Review (June 2001), USEPA Region 1 Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses (December 1996), and USEPA Region 1 Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses (February 1989) to the greatest extent practicable for non-CLP data.

Data validation specifications require that various data qualifiers be assigned when a deficiency is detected or when a result is less than its detection limit. If no qualifier is assigned to a result that has been validated, the data user is assured that no technical deficiencies were identified during validation. The qualification flags used are defined as follows:

U – Indicates that the chemical was not detected at the numerical detection limit (sample-specific detection limit) noted. Non-detected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – Indicates that the chemical was not detected; however, the detection limit (sample-specific detection limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J – Indicates that the chemical was detected; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is considered to be an estimate of the true concentration.

UR – Indicates that the chemical may or may not be present. The non-detected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (e.g., holding times missed by a factor of two times the specified time limit, severe calibration non-compliances, and extremely low analyte recoveries).

R – Indicates that the chemical may or may not be present. The positive analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

The preceding data qualifiers may be categorized as indicative of major or minor problems. Major problems are defined as issues that result in the rejection of data and qualification with UR or R data validation qualifiers. These data are considered invalid and are not used for decision-making purposes unless they are used in a qualitative way and the use is justified and documented. Minor problems are defined as issues resulting in the estimation of data and qualification with U, J, and UJ data validation qualifiers. Estimated analytical results are considered to be suitable for decision-making purposes unless the data use requirements are very stringent and the qualifier indicates a deficiency that is incompatible with the intended data use. A U qualifier does not necessarily indicate that a data deficiency exists because all non-detect values are flagged with the U qualifier regardless of whether a quality deficiency has been detected.

3.1.2 Data Validation Outputs

After data were validated, a list was developed of non-conformities requiring data qualifier flags that were used to alert the data user to inaccurate or imprecise data. For situations in which several QC criteria were out of specification, the data validator made professional judgments and/or comments on the validity of the overall data package. The reviewer then prepared a technical memorandum presenting qualification of the data, if necessary, and the rationale for making such qualifications. The net result was a data package that had been carefully reviewed for its adherence to prescribed technical requirements. Pertinent quality estimates are summarized in a more quantitative format in the following section.

3.1.3 Data Quality Review

DQIs are parameters that are monitored to help establish the quality of data generated during an investigation. Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of laboratory samples (e.g., laboratory duplicates). Individually, field and laboratory DQIs provide measures of the performance of the respective investigative operations (field or laboratory). During data validation, individual QC results were evaluated. If individual QC results were acceptable, no validation flag was assigned to an analytical result; otherwise, a flag indicating the type of QC deficiency was assigned to the result. Table 3-1 lists all the data that were rejected and the reasons for the rejections. This data is considered un-useable for any purposes. The semivolatile compound pentachlorophenol is considered a poor responder, and several calibrations failed due to low pentachlorophenol response. Table 3-2 lists all the data that were qualified and the reasons for the qualification. The qualified data from Table 3-2 are useable for their intended purpose.

3.1.4 Completeness

Completeness is a measure of the number of valid samples or measurements that are available relative to the number of samples or measurements that were intended to be generated. For this project, completeness was measured on two different bases, samples collected and laboratory measurements, as follows:

- Sample completeness was a measure of the usable samples collected compared to those intended to be collected.

- Laboratory measurement completeness was a measure of the amount of usable, valid, laboratory measurements obtained for each target analyte.

Usable, valid samples (or results) were those judged, after data assessment, to represent the sampling populations and to not have been disqualified for use through data validation or additional data review. Completeness was determined using the following equation:

$$\%C = \frac{V}{T} \text{ x } 100$$

where %C = percent completeness

V = number of samples (or results) determined to be valid

T = total number of planned samples (or results)

All samples proposed were collected during all four sampling rounds. The percent completeness (%C) for laboratory measurement for all analytical fractions for all four rounds was 100, with the exception of SW-846 Methods 8270C and 8270C-SIM. One 4-nitroaniline and six pentachlorophenol data points were rejected. With the seven rejected semivolatile data points, the laboratory completeness for semivolatiles was approximately 98 percent, which is still greater than the 90 percent quality control level.

3.1.5 Sensitivity

The method detection limits (MDLs) reported by the laboratory were less than the action limits specified for the Connecticut Remediation Standards Regulations (RSRs) (January 1996 and October 24, 2005) and NSB-NLON General Permit for the Discharge of Stormwater Associated with Industrial Activity (DEP-PERD-GP-014, Issuance Date: October 1, 2002 and Modified Date: July 15, 2003). Therefore, sensitivity specifications were not adversely affected for this project, and data quality objectives were met.

3.1.6 Laboratory Accuracy

Accuracy in the laboratory is measured through the comparison of a spiked sample or laboratory control sample (LCS) result to a known or calculated value and is expressed as a percent recovery (%R). It was also assessed by monitoring the analytical recovery of select surrogate compounds added to samples that were analyzed by organic chromatographic methods. LCSs were used to assess the accuracy of laboratory operations with minimal sample matrix effects. MS and surrogate compound analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement. LCS and MS analyses were performed at a frequency of one per 20 associated samples. Laboratory accuracy was assessed by comparing calculated %R values to accuracy control limits specified by the laboratory.

Percent recovery is calculated using the following equation:

$$\%R = \frac{(S_s - S_o)}{S} \times 100$$

where $\%R$ = percent recovery

S_s = result of spiked sample

S_o = result of non-spiked sample

S = concentration of spiked amount.

All MS/MSD recovery, LCS/LCS duplicate(LCSD) recovery, and surrogate recovery non-compliances that resulted in qualification of data are presented in Table 3-2. Although data are qualified due to MS/MSD, LCS/LCSD, and surrogate recovery non-compliances, this is not expected to adversely affect data quality because the data are still useable for risk assessment. Three pentachlorophenol data points were rejected due to MS/MSD, LCS/LCSD, and/or surrogate recoveries less than 10 percent. These data are not useable for risk assessment because of low bias, and its affect on data quality will be assessed in the risk assessment section of this report.

3.1.7 Laboratory Precision

Precision is a measure of the degree to which two or more measurements are in agreement and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions.

Precision for chemical parameters is expressed as a relative percent difference (RPD), which is defined as the ratio of the difference to the mean for the two values being evaluated. RPDs, typically expressed as percentages, are used to evaluate both field and laboratory duplicate precision and are calculated as follows:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where RPD = relative percent difference

V1, V2 = two results obtained by analyzing duplicate samples

The precision estimates obtained from duplicate field samples encompass the combined uncertainty associated with sample collection, homogenization, splitting, handling, laboratory and field storage (as applicable), preparation for analysis, and analysis. In contrast, precision estimates obtained from analyzing duplicate laboratory samples incorporate only homogenization, subsampling, preparation for analysis, laboratory storage (if applicable), and analysis uncertainties.

Field duplicate imprecision was noted for several parameters in several samples in Table 3-2. However, none of these field duplicate non-compliances resulted in rejection of the data. All MS/MSD, LCS/LCSD, and field duplicate precision data are considered useable for risk assessment.

3.1.8 Comparability

Comparability is defined as the confidence with which one data set can be compared with another (e.g., among sampling points and among sampling events). Comparability was achieved by using standardized sampling and analysis methods, and standardized data reporting formats. Comparability of laboratory measurements was achieved primarily through the use and documentation of standard sampling and analytical methods. Results were reported in units that ensured comparability with previous data and with current state and federal standards and guidelines. Comparability of laboratory measurements was assessed primarily through the use of QC samples and through adherence to the QA plan.

Calibration non-compliances occurred in the volatile, semivolatile, and metals fractions for several samples. Six of the seven rejected data points are due to poor instrument response for semivolatile compounds 4-nitroaniline and pentachlorophenol. These compounds are considered poor responders by SW-846 Method 8270C. The low instrument responses for 4-nitroaniline and pentachlorophenol indicate a low bias, and positive results for these compounds at the low end of the calibration curve may not be detected.

3.1.9 Representativeness

Representativeness is an expression of the degree to which data accurately and precisely depict the actual characteristics of a population or environmental condition existing at the site.

The Site 23 Underdrain Metering Pit Sampling Work Plan (Tetra Tech, 2007a) and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would be accurate representations of actual site conditions. It is believed that all reported data are adequately representative of site conditions.

3.2 QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

Table 3-3 summarizes the actual detection limits achieved by the laboratory that analyzed the Year 1 groundwater samples. By comparing the required and achieved detection limits, it is evident that the analyses performed by the project laboratory met the project requirements (i.e., achieved detection limits less than remedial goals and monitoring criteria).

3.3 ANALYTICAL DATA EVALUATION

The results of the underdrain metering pit sampling events are discussed below. The analytical results for the February 2008 sampling event are provided in Appendix B. The analytical results for Rounds 1 through 3 were previously provided in their respective quarterly reports (Tetra Tech, 2007b, 2007c, and 2008). The analytical data for all Year 1 quarterly sampling events are summarized in Table 3-3 and Appendix C.

Round 1

Seven VOCs (bromodichloromethane, chloroform, cis-1,2-dichloroethene, isopropylbenzene, methyl tert-butyl ether (MTBE), tetrachloroethene, and trichloroethene), one PAH (2-methylnaphthalene), 10 metals (aluminum, barium, calcium, iron, lead, magnesium, manganese, potassium, sodium, and zinc), and ETPH were detected during the Round 1 event in either the original or duplicate sample. The original sample and duplicate sample concentrations were comparable, with the exception of bromodichloromethane and selenium. Bromodichloromethane was detected in the original sample and not in the duplicate sample. Selenium was detected in the filtered and unfiltered duplicate sample for metals and not in the original sample. None of the detected concentrations exceeded any established CTDEP criteria.

Because all Round 1 concentrations were in compliance with criteria, it was concluded that the groundwater does not represent a significant risk to human health or the environment under current conditions.

Round 2

Six VOCs (cyclohexane, cis-1,2-dichloroethene, isopropylbenzene, MTBE, tetrachloroethene, and trichloroethene), no PAHs, 15 metals (aluminum, arsenic, barium, calcium, chromium, copper, iron, lead, magnesium, manganese, potassium, silver, sodium, vanadium, and zinc), and ETPH were detected during the Round 2 event. All of the Round 2 results were in compliance with CTDEP criteria except for arsenic in the unfiltered sample. Arsenic was detected at a concentration of 13.9 micrograms per liter (µg/L) in the unfiltered sample, which exceeds the surface water protection criterion (4 µg/L). However, arsenic was detected at 1.2 µg/L in the filtered sample, which is less than the criteria, and was not detected at similar concentrations in previous or subsequent sampling events. Because the arsenic concentration detected in the filtered sample was significantly less than the concentration detected in the unfiltered sample, it is likely that the unfiltered arsenic concentration is a result of suspended solid particles in the water and is not indicative of groundwater quality. Therefore, because all of the filtered sample concentrations were in compliance with criteria, it was concluded that the groundwater did not represent a significant risk to human health or the environment.

Round 3

Four VOCs (cis-1,2-dichloroethene, MTBE, tetrachloroethene, and trichloroethene), 20 PAHs (1-methylnaphthalene, 2-methylnaphthalene, 4-nitroaniline, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)flouranthene, benzo(g,h,i)perylene, benzo(k)flouranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, hexachlorobenzene, hexachlorobutadiene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene), 12 metals (aluminum, barium, calcium, chromium, cobalt, iron, magnesium, manganese, nickel, potassium, sodium, and zinc), and ETPH were detected during the Round 3 event. Round 3 was the only event which PAHs were detected at significant concentrations. Concentrations were less than criteria except for seven PAH concentrations as shown in Table 3-3. Concentrations of PAHs exceeded Surface Water Protection Criteria but were all low (approx.

1 µg/L or less). Similar concentrations of PAHs were detected once before in May 2001 during a series of four sampling rounds conducted by another Navy contractor after the metering pit was installed. Although 21 PAHs were detected in sample S23GWMPM-03, only three PAHs were detected in the field duplicate sample, and none of those detections exceeded of Surface Water Protection Criteria. The discrepancy between the original sample and field duplicate may indicate that the PAH results are not truly indicative of groundwater quality. The sample collection technicians have noted that an orange/rust colored floc forms in the bottom of the manhole between sampling events. Every attempt is made to limit collection of the floc with the groundwater; however, it is thought that the sampling technique disturbed the floc, which resulted in sediment particles being collected with the aqueous sample. The PAHs could then have been bound to the sediment particles. Both filtered and unfiltered samples were collected for inorganics analysis because it was anticipated that sediment particles in the aqueous samples may be problematic. The inorganic data show that there have been fewer detections of metals in filtered samples than in unfiltered samples, which suggests that sediment particles are present to some extent.

Based on the discrepancy between the original sample and field duplicate results and the low levels of PAHs detected, it was concluded that the PAH results were not indicative of groundwater quality and that the groundwater does not represent a significant risk to human health or the environment. To confirm that the PAH results are related to sediment particles, it was recommended that both total and filtered PAH samples be collected during the Round 4 sampling event.

A discrepancy between the original and field duplicate results for ETPH was also identified. The original sample result for ETPH was non-detect; however, the concentration in the field duplicate was 1600 µg/L, which also supports the possibility that sediment particles could be affecting the results. The detection of ETPH in the field duplicate was less than the allowable concentration listed in the general stormwater permit of 2,500 µg/L (for oil and grease).

In addition to the discrepancy between sample and duplicate results for hexachlorobenzene (1.2 µg/L and 0.2 U µg/L), as was the case for many PAHs, it was noted during Round 3 that the detection limit for hexachlorobenzene in the duplicate sample was greater than the Connecticut Surface Water Protection Criterion (0.077 µg/L). The reported detection limit (0.2 µg/L) is the practical quantitation limit (PQL) for Method SW-846 8270C SIM performed by the project laboratory. This method is typically used by commercial laboratories to obtain the lowest possible detection limit. Therefore, because the Surface Water Protection Criteria (0.077 µg/L) is approximately one order of magnitude less than the PQL, current technology available to commercial laboratories is not able to reach the required detection limit. According to 22a-133k-3(f)(4)(B) of the Connecticut RSRs, compliance with groundwater criterion can be shown when the detected concentration is less than the lowest concentration that can be consistently and accurately quantified (i.e., the lowest detection limit achievable by current analytical methods). Therefore, it was concluded that the 0.2 µg/L detection limit could be used as a surrogate Surface Water Protection Criterion for hexachlorobenzene.

Because of the anomalous Round 3 results, the impact of Site 23 groundwater on human health and the environment was inconclusive.

Round 4

Five VOCs (benzene, cis-1,2-dichloroethene, MTBE, tetrachloroethene, and trichloroethene) and 12 metals (aluminum, arsenic, barium, calcium, cobalt, iron, magnesium, manganese, nickel, potassium, sodium, and zinc) were detected during the Round 4 sampling event. None of the detected concentrations exceeded any established Connecticut criteria.

Both filtered and unfiltered samples were collected for PAH and ETPH analysis during Round 4 to verify Round 3 results suspected to be related to suspended sediment particles. Fewer PAHs were detected during Round 4 than Round 3 and four of five PAH concentrations detected during Round 4 were less than Round 3 concentrations. Unlike Round 3 when seven PAHs were detected above established CTDEP criteria, the PAH concentrations detected during Round 4 did not exceed any established CTDEP criteria. ETPH was not detected in either the unfiltered or filtered sample during Round 4 compared to a detection of 1,600 µg/L during Round 3. The Round 4 PAH and ETPH results were also similar to the data collected during Rounds 1 and 2, which supports the theory that the Round 3 results were anomalous. However, it should be noted that during Round 4, no PAHs were detected in the unfiltered sample, but five PAHs were detected in the filtered sample. This data suggests that a factor (e.g., filter, bottleware, or laboratory equipment) other than suspended sediment particles contributed to the PAHs detected during Round 4. A similar factor may have caused the anomalous Round 3 results. Therefore, the Round 4 results suggest that a factor other than suspended sediments in the sample may have caused the anomalous results during Round 3.

Therefore, because all of the Round 4 sample concentrations were in compliance with the criteria, it was concluded that groundwater does not represent a significant risk to human health or the environment under current conditions.

3.4 STATISTICAL/TREND ANALYSIS

It was anticipated that statistical or trend analysis would be performed for the Site 23 data; however, because of the limited number of contaminants detected and the inconsistent/infrequent detection of chemicals in excess of criteria, no statistical or trend analysis is warranted. This type of analysis may be performed in the future if additional data are collected and the results indicate the need for the analysis.

3.5 MEMORANDUM REGARDING HUMAN HEALTH RISKS ASSOCIATED WITH SITE 23 GROUNDWATER (MAY 19, 2008)

The following section summarizes the human health risk assessment (HHRA) memoranda that were completed to evaluate potential for adverse impacts on human health resulting from exposure to contaminated groundwater at Site 23. The complete memorandum is provided in Appendix D.

Historical and current information pertaining to Site 23 groundwater were reviewed to determine if Site 23 groundwater poses a threat to human health and the environment. Historical information reviewed as part of the evaluation included the Basewide Groundwater Operable Unit Remedial Investigation Report (BGOURI) (Tetra Tech, 2002) and data collected as part of the storm sewer rehabilitation (FWEC, 2001). Current data reviewed included the year of underdrain metering pit data collected through February 2008. USEPA and CTDEP guidance updated since the BGOURI were used in the evaluation.

The conclusions of the evaluation are as follows:

- The Human Health Risk Assessment (HHRA) performed during the BGOURI evaluated potential risks from exposures to groundwater by construction workers and hypothetical residents, although it is unlikely that direct contact exposures to Site 23 groundwater would occur based on current and expected future site use. Cumulative risks were less than or within USEPA and CTDEP acceptable levels. However, chemical-specific risks for tetrachloroethene exceeded the CTDEP target level for individual chemicals, although the maximum detected concentration of tetrachloroethene was less than its CTDEP Remediation Standard Regulations (RSR) (5 µg/L). Concentrations of tetrachloroethene in Site 23 groundwater have decreased from 3 µg/L in the BGOURI to 0.3 µg/L during Round 4 sampling. Chemical-specific risks associated with tetrachloroethene would now be less than the CTDEP target level for individual chemicals.

- Human Health Risk Assessment guidance has been revised since the BGOURI HHRA was prepared but the changes in the guidance would not change the conclusions of the HHRA.

- Concentrations of chemicals in groundwater samples after the storm sewer rehabilitation were greatest in samples collected in August and October 2000, right after completion of construction and decreased significantly in subsequent sampling rounds.

- Concentrations of all chemicals detected in groundwater during the first year of the underdrain metering pit sampling were less than CTDEP Surface Water Protection and Volatilization Criteria with the exception of arsenic and several PAHs. The concentration of total arsenic in the Round 2 sample exceeded the Surface Water Protection Criteria although the concentration of arsenic in the filtered sample was less than the Surface Water Protection Criterion. The arsenic detected in the unfiltered sample is believed to be a result of suspended solid particles in the water and the filtered sample is more indicative of groundwater quality. Concentrations of acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, hexachlorobenzene, and phenanthrene exceeded the Surface Water Protection Criterion. These chemicals were not detected in the duplicate sample collected in Round 3 and these chemicals were not detected in the Round 4 sample.

- In general, concentrations of chemicals in Site 23 groundwater have decreased over time except as noted above.

- Potential risks for construction workers exposed to Site 23 groundwater are still acceptable using the analytical results from the four rounds of quarterly sampling. Potential risks for hypothetical residents exposed to Site 23 groundwater exceed acceptable levels, although Site 23 is not suitable for residential development.

Based on existing information, under current and expected land use, Site 23 groundwater does not pose a significant threat to human health or the environment. Adverse health effects are possible under hypothetical residential land use.

3.6 MEMORANDUM REGARDING VAPOR INTRUSION EVALUATION FOR GROUNDWATER AT OPERABLE UNIT 9 (MAY 30, 2008)

Groundwater data from Site 23, which is within operable unit (OU) 9, was evaluated to determine if there were unacceptable risks associated with vapor intrusion into buildings. The complete memorandum for OU9 is provided in Appendix E. Data from a total of eight sites (i.e., 2, 3, 7, 14, 15, 18, 20, and 23) were evaluated in the memorandum, but only the risk results for Site 23, which are called out in separate sections of the memorandum, are applicable to this report.

The most recent groundwater data that was available for the site were used in the evaluation. Concentrations of volatile organic compounds (VOCs) in groundwater were compared to screening criteria for vapor intrusion. Screening criteria were obtained from USEPA's OSWER Draft Guidance for Evaluating the Vapor Intrusion into Indoor Air from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), November 2002, CTDEP's Proposed Revisions - Connecticut's Remediation Standard Regulations Volatilization Criteria, March 2003, and USEPA Region I (USEPA, 2008). The screening criteria are for residential exposures and are based on an incremental lifetime cancer risk (ILCR) of 1 x 10^{-6} or a hazard index (HI) of 1. If the risk-based screening criterion is less than the Maximum

Contaminant Level (MCL) the 2002 EPA guidance recommends using the MCL as the screening level. However, USEPA Region I guidance does not allow for MCLs to be used as screening criteria. USEPA Region I provided risk-based screening levels for those cases where the USEPA draft guidance recommended MCLs as screening levels. If chemicals were detected at concentrations exceeding either screening criteria, the chemicals were further evaluated using USEPA's Johnson and Ettinger Vapor Intrusion Model.

Year 1 quarterly groundwater data were used to evaluate the potential for vapor intrusion at Site 23. Concentrations of chloroform detected in one sample and trichloroethene detected in four samples exceeded the USEPA screening criteria. Therefore, chloroform and trichloroethene were further evaluated using the Johnson and Ettinger Vapor Intrusion Model.

Residential exposures, at Site 23 the ILCR for chloroform of 2×10^{-6} and trichloroethene of 4×10^{-6} based on the draft USEPA toxicity criteria are less than the CTDEP acceptable level for cumulative exposures but exceed the CTDEP acceptable level of 1×10^{-6} for individual chemicals. The ILCR for trichloroethene for residential exposures based on the California Environmental Protection Agency (Cal EPA) toxicity value and ILCRs for industrial exposures for trichloroethene and vinyl chloride are all less than 1×10^{-6}. Also the maximum detected concentration of chloroform in groundwater samples at Site 23 of 3 µg/L is less than the residential CTDEP RSR of 26 µg/L for vapor intrusion.

Modeling results showed that cancer risks for chloroform under a residential scenario were within USEPA acceptable levels but exceeded CTDEP acceptable levels. Cancer risks for trichloroethene based upon California EPA toxicity criteria were within USEPA and CTDEP acceptable levels for residential and industrial scenarios but cancer risks for a residential scenario based on draft USEPA toxicity criteria exceeded CTDEP acceptable levels. Further Applicable or Relevant and Appropriate Requirements (ARARs) showed that vapor intrusion is not an issue at Site 23. No further action is required for vapor intrusion issues.

TABLE 3-1

DATA REJECTION AND REASONS FOR REJECTIONS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT (µG/L)	VALIDATION QUALIFIER	QUALIFICATION CODE	REASON FOR QUALIFICATION
S23GWMPM-03-D	4-NITROANILINE	1	UR	C	Calibration non-compliance.
S23GWMPM01	PENTACHLOROPHENOL	1	UR	CDE	Calibration non-compliance, MS/MSD recovery noncompliance, and LCS/LCSD recovery non-compliance.
S23GWMPM01-D	PENTACHLOROPHENOL	1	UR	CE	Calibration non-compliance and LCS/LCSD recovery non-compliance.
S23GWMPM02	PENTACHLOROPHENOL	1	UR	C	Calibration non-compliance.
S23GWMPM-03	PENTACHLOROPHENOL	1	UR	C	Calibration non-compliance
S23GWMPM-03-D	PENTACHLOROPHENOL	1	UR	C	Calibration non-compliance
S23GWMPM04	PENTACHLOROPHENOL	1	UR	R	Surrogate recovery non-compliance.

MS/MSD = Matrix spike/matrix spike duplicate
LCS/LCSD = Laboratory control sample/LCS duplicate

TABLE 3-2

DATA QUALIFICATION AND REASONS FOR QUALIFICATIONS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT (µG/L)	VALIDATION QUALIFIER	QUALIFICATION CODE	REASON FOR QUALIFICATION
S23GWMPM01	2,4-DIMETHYLPHENOL	10	UJ	D	MS/MSD recovery non-compliance
S23GWMPM01	2,4-DINITROPHENOL	25	UJ	C	Calibration non-compliance.
S23GWMPM01	2-METHYLNAPHTHALENE	0.17	J	P	Uncertainty near the detection limit.
S23GWMPM01	4-NITROPHENOL	25	UJ	C	Calibration non-compliance.
S23GWMPM01	ALUMINUM	20.4	J	P	Uncertainty near the detection limit.
S23GWMPM01	ANTIMONY	2.3	U	A	Laboratory blank contamination.
S23GWMPM01	ARSENIC	3.7	U	A	Laboratory blank contamination.
S23GWMPM01	ARSENIC	3.5	U	A	Laboratory blank contamination.
S23GWMPM01	BENZO(A)PYRENE	0.2	UJ	D	MS/MSD recovery non-compliance
S23GWMPM01	BENZO(G,H,I)PERYLENE	0.2	UJ	D	MS/MSD recovery non-compliance
S23GWMPM01	BENZO(K)FLUORANTHENE	0.2	UJ	C	Calibration non-compliance.
S23GWMPM01	BIS(2-ETHYLHEXYL)PHTHALATE	1	UJ	CD	Calibration non-compliance and MS/MSD recovery non-compliance
S23GWMPM01	BROMODICHLOROMETHANE	0.3	J	P	Uncertainty near the detection limit.
S23GWMPM01	CHLOROETHANE	0.5	UJ	C	Calibration non-compliance.
S23GWMPM01	CHLOROFORM	3	J	G	Field duplicate imprecision.
S23GWMPM01	CHROMIUM	0.94	U	A	Laboratory blank contamination.
S23GWMPM01	CHROMIUM	1.2	U	A	Laboratory blank contamination.
S23GWMPM01	CIS-1,2-DICHLOROETHENE	0.3	J	P	Uncertainty near the detection limit.
S23GWMPM01	COBALT	0.84	U	A	Laboratory blank contamination.
S23GWMPM01	COBALT	0.67	U	A	Laboratory blank contamination.
S23GWMPM01	COPPER	3	U	A	Laboratory blank contamination.
S23GWMPM01	COPPER	14.9	U	A	Laboratory blank contamination.
S23GWMPM01	DIBENZO(A,H)ANTHRACENE	0.2	UJ	D	MS/MSD recovery non-compliance
S23GWMPM01	DI-N-OCTYL PHTHALATE	10	UJ	C	Calibration non-compliance.
S23GWMPM01	INDENO(1,2,3-CD)PYRENE	0.2	UJ	D	MS/MSD recovery non-compliance
S23GWMPM01	ISOPROPYLBENZENE	0.1	J	P	Uncertainty near the detection limit.
S23GWMPM01	LEAD	1.3	J	P	Uncertainty near the detection limit.
S23GWMPM01	MERCURY	0.03	U	A	Laboratory blank contamination.
S23GWMPM01	MERCURY	0.03	U	A	Laboratory blank contamination.
S23GWMPM01	METHYLENE CHLORIDE	0.5	UJ	C	Calibration non-compliance.
S23GWMPM01	NICKEL	1	U	A	Laboratory blank contamination.
S23GWMPM01	NICKEL	1.1	U	A	Laboratory blank contamination.
S23GWMPM01	TETRACHLOROETHENE	0.3	J	P	Uncertainty near the detection limit.
S23GWMPM01	THALLIUM	0.99	U	A	Laboratory blank contamination.
S23GWMPM01	THALLIUM	1.2	U	A	Laboratory blank contamination.
S23GWMPM01	TPH (C09-C36)	55	J	P	Uncertainty near the detection limit.
S23GWMPM01	TRICHLOROETHENE	0.4	J	P	Uncertainty near the detection limit.

DATA QUALIFICATION AND REASONS FOR QUALIFICATIONS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT (µG/L)	VALIDATION QUALIFIER	QUALIFICATION CODE	REASON FOR QUALIFICATION
S23GWMPM01	TRICHLOROFLUOROMETHANE	0.5	UJ	C	Calibration non-compliance.
S23GWMPM01	VANADIUM	1.3	U	A	Laboratory blank contamination.
S23GWMPM01	VANADIUM	0.7	U	A	Laboratory blank contamination.
S23GWMPM01	ZINC	21.3	J	C	Calibration non-compliance.
S23GWMPM01	ZINC	21.4	J	C	Calibration non-compliance
S23GWMPM01-D	2,4-DINITROPHENOL	25	UJ	C	Calibration non-compliance.
S23GWMPM01-D	2-METHYLNAPHTHALENE	0.16	J	P	Uncertainty near the detection limit.
S23GWMPM01-D	4-NITROPHENOL	25	UJ	C	Calibration non-compliance.
S23GWMPM01-D	ALUMINUM	36.7	J	P	Uncertainty near the detection limit.
S23GWMPM01-D	ANTIMONY	1.5	U	A	Laboratory blank contamination.
S23GWMPM01-D	ANTIMONY	1.6	U	A	Laboratory blank contamination.
S23GWMPM01-D	ARSENIC	3	U	A	Laboratory blank contamination.
S23GWMPM01-D	ARSENIC	2.2	U	A	Laboratory blank contamination.
S23GWMPM01-D	BENZO(K)FLUORANTHENE	0.2	UJ	C	Calibration non-compliance.
S23GWMPM01-D	BIS(2-ETHYLHEXYL)PHTHALATE	1	UJ	C	Calibration non-compliance.
S23GWMPM01-D	CHLOROETHANE	0.5	UJ	C	Calibration non-compliance.
S23GWMPM01-D	CHLOROFORM	2	J	G	Field duplicate imprecision.
S23GWMPM01-D	CHROMIUM	0.81	U	A	Laboratory blank contamination.
S23GWMPM01-D	CHROMIUM	0.44	U	A	Laboratory blank contamination.
S23GWMPM01-D	CIS-1,2-DICHLOROETHENE	0.2	J	P	Uncertainty near the detection limit.
S23GWMPM01-D	COBALT	0.64	U	A	Laboratory blank contamination.
S23GWMPM01-D	COBALT	0.86	U	A	Laboratory blank contamination.
S23GWMPM01-D	COPPER	3	U	A	Laboratory blank contamination.
S23GWMPM01-D	COPPER	2.2	U	A	Laboratory blank contamination.
S23GWMPM01-D	DI-N-OCTYL PHTHALATE	10	UJ	C	Calibration non-compliance.
S23GWMPM01-D	ISOPROPYLBENZENE	0.09	J	P	Uncertainty near the detection limit.
S23GWMPM01-D	LEAD	1.8	J	P	Uncertainty near the detection limit.
S23GWMPM01-D	MERCURY	0.04	U	A	Laboratory blank contamination.
S23GWMPM01-D	MERCURY	0.04	U	A	Laboratory blank contamination.
S23GWMPM01-D	METHYLENE CHLORIDE	0.5	UJ	C	Calibration non-compliance.
S23GWMPM01-D	NICKEL	0.77	U	A	Laboratory blank contamination.
S23GWMPM01-D	NICKEL	0.88	U	A	Laboratory blank contamination.
S23GWMPM01-D	SELENIUM	2	J	P	Uncertainty near the detection limit.
S23GWMPM01-D	SELENIUM	1.7	J	P	Uncertainty near the detection limit.
S23GWMPM01-D	TETRACHLOROETHENE	0.3	J	P	Uncertainty near the detection limit.
S23GWMPM01-D	THALLIUM	2.3	U	A	Laboratory blank contamination.
S23GWMPM01-D	THALLIUM	0.93	U	A	Laboratory blank contamination.
S23GWMPM01-D	TRICHLOROETHENE	0.3	J	P	Uncertainty near the detection limit.

DATA QUALIFICATION AND REASONS FOR QUALIFICATIONS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT (µG/L)	VALIDATION QUALIFIER	QUALIFICATION CODE	REASON FOR QUALIFICATION
S23GWMPM01-D	TRICHLOROFLUOROMETHANE	0.5	UJ	C	Calibration non-compliance.
S23GWMPM01-D	VANADIUM	1.4	U	A	Laboratory blank contamination.
S23GWMPM01-D	VANADIUM	0.56	U	A	Laboratory blank contamination.
S23GWMPM01-D	ZINC	19.5	J	C	Calibration non-compliance.
S23GWMPM02	2,4,6-TRICHLOROPHENOL	10	UJ	D	MS/MSD recovery non-compliance
S23GWMPM02	2,4-DIMETHYLPHENOL	10	UJ	D	MS/MSD recovery non-compliance
S23GWMPM02	2,4-DINITROPHENOL	25	UJ	C	Calibration non-compliance.
S23GWMPM02	2-CHLOROPHENOL	10	UJ	D	MS/MSD recovery non-compliance
S23GWMPM02	4,6-DINITRO-2-METHYLPHENOL	25	UJ	C	Calibration non-compliance.
S23GWMPM02	4-NITROANILINE	1	UJ	C	Calibration non-compliance.
S23GWMPM02	ALUMINUM	21.3	J	P	Uncertainty near the detection limit.
S23GWMPM02	ARSENIC	1.2	J	P	Uncertainty near the detection limit.
S23GWMPM02	BUTYL BENZYL PHTHALATE	10	UJ	C	Calibration non-compliance.
S23GWMPM02	CADMIUM	0.64	U	A	Laboratory blank contamination.
S23GWMPM02	CHROMIUM	0.3	J	P	Uncertainty near the detection limit.
S23GWMPM02	CIS-1,2-DICHLOROETHENE	0.3	J	P	Uncertainty near the detection limit.
S23GWMPM02	COBALT	0.47	J	P	Uncertainty near the detection limit.
S23GWMPM02	COPPER	0.7	U	A	Laboratory blank contamination.
S23GWMPM02	CYCLOHEXANE	0.1	J	P	Uncertainty near the detection limit.
S23GWMPM02	ISOPROPYLBENZENE	0.1	J	P	Uncertainty near the detection limit.
S23GWMPM02	LEAD	1.1	U	A	Laboratory blank contamination.
S23GWMPM02	METHYL TERT-BUTYL ETHER	0.4	J	P	Uncertainty near the detection limit.
S23GWMPM02	NICKEL	0.78	J	P	Uncertainty near the detection limit.
S23GWMPM02	SELENIUM	2.4	U	A	Laboratory blank contamination.
S23GWMPM02	TETRACHLOROETHENE	0.4	J	P	Uncertainty near the detection limit.
S23GWMPM02	THALLIUM	0.98	U	A	Laboratory blank contamination.
S23GWMPM02	THALLIUM	1.7	U	A	Laboratory blank contamination.
S23GWMPM02	TPH (C09-C36)	140	J	D	MS/MSD recovery non-compliance
S23GWMPM02	TRICHLOROETHENE	0.5	J	P	Uncertainty near the detection limit.
S23GWMPM-03	1-METHYLNAPHTHALENE	0.96	J	D	MS/MSD recovery non-compliance
S23GWMPM-03	2,2'-OXYBIS(1-CHLOROPROPANE)	10	UJ	H	Holding time exceedance.
S23GWMPM-03	2,4,5-TRICHLOROPHENOL	25	UJ	H	Holding time exceedance.
S23GWMPM-03	2,4,6-TRICHLOROPHENOL	10	UJ	H	Holding time exceedance.
S23GWMPM-03	2,4-DICHLOROPHENOL	10	UJ	H	Holding time exceedance.
S23GWMPM-03	2,4-DIMETHYLPHENOL	10	UJ	DH	MS/MSD recovery non-compliance and holding time exceedance.
S23GWMPM-03	2,4-DINITROPHENOL	25	UJ	H	Holding time exceedance.
S23GWMPM-03	2,4-DINITROTOLUENE	10	UJ	H	Holding time exceedance.

TABLE 3-2

DATA QUALIFICATION AND REASONS FOR QUALIFICATIONS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT (µG/L)	VALIDATION QUALIFIER	QUALIFICATION CODE	REASON FOR QUALIFICATION
S23GWMPM-03	2,6-DINITROTOLUENE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	2-CHLORONAPHTHALENE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	2-CHLOROPHENOL	10	UJ	DH	MS/MSD recovery non-compliance and holding time exceedance.
S23GWMPM-03	2-METHYLNAPHTHALENE	1.1	J	DG	MS/MSD recovery non-compliance and field duplicate imprecision.
S23GWMPM-03	2-METHYLPHENOL	10	UJ	H	Holding time exceedance.
S23GWMPM-03	2-NITROANILINE	25	UJ	H	Holding time exceedance.
S23GWMPM-03	2-NITROPHENOL	10	UJ	H	Holding time exceedance.
S23GWMPM-03	3&4-METHYLPHENOL	10	UJ	DH	MS/MSD recovery non-compliance and holding time exceedance.
S23GWMPM-03	3,3'-DICHLOROBENZIDINE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	3-NITROANILINE	25	UJ	CH	Calibration non-compliance and holding time exceedance.
S23GWMPM-03	4,6-DINITRO-2-METHYLPHENOL	25	UJ	H	Holding time exceedance.
S23GWMPM-03	4-BROMOPHENYL PHENYL ETHER	10	UJ	H	Holding time exceedance.
S23GWMPM-03	4-CHLORO-3-METHYLPHENOL	10	UJ	H	Holding time exceedance.
S23GWMPM-03	4-CHLOROANILINE	10	UJ	CH	Calibration non-compliance and holding time exceedance.
S23GWMPM-03	4-CHLOROPHENYL PHENYL ETHER	10	UJ	H	Holding time exceedance.
S23GWMPM-03	4-NITROANILINE	0.75	J	CDP	Calibration non-compliance, MS/MSD recovery non-compliance, and uncertainty near the detection limit.
S23GWMPM-03	4-NITROPHENOL	25	UJ	CH	Calibration non-compliance and holding time exceedance.
S23GWMPM-03	ACENAPHTHENE	0.83	J	G	Field duplicate imprecision.
S23GWMPM-03	ACENAPHTHYLENE	0.9	J	G	Field duplicate imprecision.
S23GWMPM-03	ANTHRACENE	0.92	J	G	Field duplicate imprecision.
S23GWMPM-03	ANTIMONY	1.8	U	A	Laboratory blank contamination.
S23GWMPM-03	ARSENIC	2.2	U	A	Laboratory blank contamination.
S23GWMPM-03	ARSENIC	1.9	U	A	Laboratory blank contamination.
S23GWMPM-03	BENZO(A)ANTHRACENE	1	J	G	Field duplicate imprecision.
S23GWMPM-03	BENZO(A)PYRENE	0.35	J	D	MS/MSD recovery non-compliance
S23GWMPM-03	BENZO(B)FLUORANTHENE	0.64	J	DG	MS/MSD recovery non-compliance and field duplicate imprecision.
S23GWMPM-03	BENZO(K)FLUORANTHENE	0.53	J	D	MS/MSD recovery non-compliance
S23GWMPM-03	BIS(2-CHLOROETHOXY)METHANE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	BIS(2-CHLOROETHYL)ETHER	10	UJ	H	Holding time exceedance.

TABLE 3-2

DATA QUALIFICATION AND REASONS FOR QUALIFICATIONS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT (µG/L)	VALIDATION QUALIFIER	QUALIFICATION CODE	REASON FOR QUALIFICATION
S23GWMPM-03	BUTYL BENZYL PHTHALATE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	CARBAZOLE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	CHRYSENE	0.76	J	G	Field duplicate imprecision.
S23GWMPM-03	CIS-1,2-DICHLOROETHENE	0.2	J	P	Uncertainty near the detection limit.
S23GWMPM-03	COPPER	0.44	U	A	Laboratory blank contamination.
S23GWMPM-03	DIBENZO(A,H)ANTHRACENE	0.14	J	DP	MS/MSD recovery non-compliance and uncertainty near the detection limit.
S23GWMPM-03	DIBENZOFURAN	10	UJ	H	Holding time exceedance.
S23GWMPM-03	DIETHYL PHTHALATE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	DIMETHYL PHTHALATE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	DI-N-BUTYL PHTHALATE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	DI-N-OCTYL PHTHALATE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	FLUORANTHENE	1.1	J	DG	MS/MSD recovery non-compliance and field duplicate imprecision.
S23GWMPM-03	FLUORENE	0.97	J	DG	MS/MSD recovery non-compliance and field duplicate imprecision.
S23GWMPM-03	HEXACHLOROBENZENE	1.2	J	DG	MS/MSD recovery non-compliance and field duplicate imprecision.
S23GWMPM-03	HEXACHLOROBUTADIENE	0.64	J	DP	MS/MSD recovery non-compliance and uncertainty near the detection limit.
S23GWMPM-03	HEXACHLOROCYCLOPENTADIENE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	HEXACHLOROETHANE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	ISOPHORONE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	LEAD	2.5	U	A	Laboratory blank contamination.
S23GWMPM-03	LEAD	2.1	U	A	Laboratory blank contamination.
S23GWMPM-03	NAPHTHALENE	1	J	DG	MS/MSD recovery non-compliance and field duplicate imprecision.
S23GWMPM-03	NITROBENZENE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	N-NITROSO-DI-N-PROPYLAMINE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	N-NITROSODIPHENYLAMINE	10	UJ	H	Holding time exceedance.
S23GWMPM-03	OIL & GREASE - HEM	1.2	UJ	D	MS/MSD recovery non-compliance
S23GWMPM-03	PHENANTHRENE	0.98	J	DG	MS/MSD recovery non-compliance and field duplicate imprecision.
S23GWMPM-03	PHENOL	10	UJ	H	Holding time exceedance.
S23GWMPM-03	PYRENE	0.84	J	DG	MS/MSD recovery non-compliance and field duplicate imprecision.
S23GWMPM-03	TETRACHLOROETHENE	0.3	J	P	Uncertainty near the detection limit.

TABLE 3-2

DATA QUALIFICATION AND REASONS FOR QUALIFICATIONS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT (µG/L)	VALIDATION QUALIFIER	QUALIFICATION CODE	REASON FOR QUALIFICATION
S23GWMPM-03	TOTAL PETROLEUM HYDROCARBONS	160	U	A	Laboratory blank contamination.
S23GWMPM-03	TRICHLOROETHENE	0.4	J	P	Uncertainty near the detection limit.
S23GWMPM-03	TRICHLOROFLUOROMETHANE	0.5	UJ	C	Calibration non-compliance.
S23GWMPM-03	VANADIUM	0.34	U	A	Laboratory blank contamination.
S23GWMPM-03-D	1,1,2-TRICHLOROETHANE	0.5	UJ	R	Surrogate recovery non-compliance.
S23GWMPM-03-D	1-METHYLNAPHTHALENE	0.048	J	P	Uncertainty near the detection limit.
S23GWMPM-03-D	2,4-DINITROPHENOL	25	UJ	C	Calibration non-compliance.
S23GWMPM-03-D	2-METHYLNAPHTHALENE	0.2	UJ	G	Field duplicate imprecision.
S23GWMPM-03-D	3,3'-DICHLOROBENZIDINE	10	UJ	C	Calibration non-compliance.
S23GWMPM-03-D	3-NITROANILINE	25	UJ	C	Calibration non-compliance.
S23GWMPM-03-D	4,6-DINITRO-2-METHYLPHENOL	25	UJ	C	Calibration non-compliance.
S23GWMPM-03-D	4-NITROPHENOL	25	UJ	C	Calibration non-compliance.
S23GWMPM-03-D	ACENAPHTHENE	0.029	J	GP	Field duplicate imprecision and uncertainty near the detection limit.
S23GWMPM-03-D	ACENAPHTHYLENE	0.2	UJ	G	Field duplicate imprecision.
S23GWMPM-03-D	ANTHRACENE	0.2	UJ	G	Field duplicate imprecision.
S23GWMPM-03-D	ANTIMONY	1.1	U	A	Laboratory blank contamination.
S23GWMPM-03-D	ANTIMONY	1.3	U	A	Laboratory blank contamination.
S23GWMPM-03-D	ARSENIC	4.7	U	A	Laboratory blank contamination.
S23GWMPM-03-D	ARSENIC	1.1	U	A	Laboratory blank contamination.
S23GWMPM-03-D	BENZO(A)ANTHRACENE	0.042	UJ	G	Field duplicate imprecision.
S23GWMPM-03-D	BENZO(B)FLUORANTHENE	0.078	UJ	G	Field duplicate imprecision.
S23GWMPM-03-D	CHRYSENE	0.2	UJ	G	Field duplicate imprecision.
S23GWMPM-03-D	CIS-1,3-DICHLOROPROPENE	0.5	UJ	R	Surrogate recovery non-compliance.
S23GWMPM-03-D	COPPER	0.68	U	A	Laboratory blank contamination.
S23GWMPM-03-D	ETHYLBENZENE	0.5	UJ	R	Surrogate recovery non-compliance.
S23GWMPM-03-D	FLUORANTHENE	0.2	UJ	G	Field duplicate imprecision.
S23GWMPM-03-D	FLUORENE	0.2	UJ	G	Field duplicate imprecision.
S23GWMPM-03-D	HEXACHLOROBENZENE	0.2	UJ	G	Field duplicate imprecision.
S23GWMPM-03-D	HEXACHLOROCYCLOPENTADIENE	10	UJ	C	Calibration non-compliance.
S23GWMPM-03-D	ISOPROPYLBENZENE	0.5	UJ	R	Surrogate recovery non-compliance.
S23GWMPM-03-D	LEAD	2.2	U	A	Laboratory blank contamination.
S23GWMPM-03-D	LEAD	2.8	U	A	Laboratory blank contamination.
S23GWMPM-03-D	NAPHTHALENE	0.088	J	GP	Field duplicate imprecision and uncertainty near the detection limit.
S23GWMPM-03-D	PHENANTHRENE	0.2	UJ	G	Field duplicate imprecision.
S23GWMPM-03-D	PYRENE	0.2	UJ	G	Field duplicate imprecision.
S23GWMPM-03-D	SELENIUM	2.3	U	A	Laboratory blank contamination.

TABLE 3-2

DATA QUALIFICATION AND REASONS FOR QUALIFICATIONS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT (µG/L)	VALIDATION QUALIFIER	QUALIFICATION CODE	REASON FOR QUALIFICATION
S23GWMPM-03-D	STYRENE	0.5	UJ	R	Surrogate recovery non-compliance.
S23GWMPM-03-D	TETRACHLOROETHENE	0.2	J	PR	Uncertainty near the detection limit and surrogate recovery non-compliance.
S23GWMPM-03-D	TOLUENE	0.5	UJ	R	Surrogate recovery non-compliance.
S23GWMPM-03-D	TOTAL PETROLEUM HYDROCARBONS	1600	J	G	Field duplicate imprecision.
S23GWMPM-03-D	TOTAL XYLENES	0.5	UJ	R	Surrogate recovery non-compliance.
S23GWMPM-03-D	TRANS-1,3-DICHLOROPROPENE	0.5	UJ	R	Surrogate recovery non-compliance.
S23GWMPM-03-D	TRICHLOROETHENE	0.3	J	PR	Uncertainty near the detection limit and surrogate recovery non-compliance.
S23GWMPM-03-D	TRICHLOROFLUOROMETHANE	0.5	UJ	C	Calibration non-compliance.
S23GWMPM04	1-METHYLNAPHTHALENE	0.093	J	P	Uncertainty near the detection limit.
S23GWMPM04	2,2'-OXYBIS(1-CHLOROPROPANE)	10	UJ	H	Holding time exceedance.
S23GWMPM04	2,4,5-TRICHLOROPHENOL	26	UJ	H	Holding time exceedance.
S23GWMPM04	2,4,6-TRICHLOROPHENOL	10	UJ	DH	MS/MSD recovery non-compliance and holding time exceedance.
S23GWMPM04	2,4-DICHLOROPHENOL	10	UJ	DH	MS/MSD recovery non-compliance and holding time exceedance.
S23GWMPM04	2,4-DIMETHYLPHENOL	10	UJ	DH	MS/MSD recovery non-compliance and holding time exceedance.
S23GWMPM04	2,4-DINITROPHENOL	26	UJ	H	Holding time exceedance.
S23GWMPM04	2,4-DINITROTOLUENE	10	UJ	H	Holding time exceedance.
S23GWMPM04	2,6-DINITROTOLUENE	10	UJ	H	Holding time exceedance.
S23GWMPM04	2-CHLORONAPHTHALENE	10	UJ	H	Holding time exceedance.
S23GWMPM04	2-CHLOROPHENOL	10	UJ	H	Holding time exceedance.
S23GWMPM04	2-METHYLNAPHTHALENE	0.21	UJ	C	Calibration non-compliance.
S23GWMPM04	2-METHYLNAPHTHALENE	0.2	UJ	C	Calibration non-compliance.
S23GWMPM04	2-METHYLPHENOL	10	UJ	H	Holding time exceedance.
S23GWMPM04	2-NITROANILINE	26	UJ	H	Holding time exceedance.
S23GWMPM04	2-NITROPHENOL	10	UJ	H	Holding time exceedance.
S23GWMPM04	3&4-METHYLPHENOL	10	UJ	DH	MS/MSD recovery non-compliance and holding time exceedance.
S23GWMPM04	3,3'-DICHLOROBENZIDINE	10	UJ	H	Holding time exceedance.
S23GWMPM04	3-NITROANILINE	26	UJ	H	Holding time exceedance.
S23GWMPM04	4,6-DINITRO-2-METHYLPHENOL	26	UJ	H	Holding time exceedance.
S23GWMPM04	4-BROMOPHENYL PHENYL ETHER	10	UJ	H	Holding time exceedance.
S23GWMPM04	4-CHLORO-3-METHYLPHENOL	10	UJ	H	Holding time exceedance.

TABLE 3-2

DATA QUALIFICATION AND REASONS FOR QUALIFICATIONS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT (µG/L)	VALIDATION QUALIFIER	QUALIFICATION CODE	REASON FOR QUALIFICATION
S23GWMPM04	4-CHLOROANILINE	10	UJ	H	Holding time exceedance.
S23GWMPM04	4-CHLOROPHENYL PHENYL ETHER	10	UJ	H	Holding time exceedance.
S23GWMPM04	4-NITROANILINE	1	UJ	C	Calibration non-compliance.
S23GWMPM04	4-NITROANILINE	1	UJ	C	Calibration non-compliance.
S23GWMPM04	4-NITROPHENOL	26	UJ	H	Holding time exceedance.
S23GWMPM04	ACENAPHTHENE	0.031	J	P	Uncertainty near the detection limit.
S23GWMPM04	BENZENE	0.2	J	P	Uncertainty near the detection limit.
S23GWMPM04	BENZO(G,H,I)PERYLENE	0.13	J	P	Uncertainty near the detection limit.
S23GWMPM04	BIS(2-CHLOROETHOXY)METHANE	10	UJ	H	Holding time exceedance.
S23GWMPM04	BIS(2-CHLOROETHYL)ETHER	10	UJ	H	Holding time exceedance.
S23GWMPM04	BIS(2-ETHYLHEXYL)PHTHALATE	1	UJ	C	Calibration non-compliance.
S23GWMPM04	BIS(2-ETHYLHEXYL)PHTHALATE	1	UJ	C	Calibration non-compliance.
S23GWMPM04	BUTYL BENZYL PHTHALATE	10	UJ	H	Holding time exceedance.
S23GWMPM04	CARBAZOLE	10	UJ	H	Holding time exceedance.
S23GWMPM04	CIS-1,2-DICHLOROETHENE	0.2	J	P	Uncertainty near the detection limit.
S23GWMPM04	DIBENZOFURAN	10	UJ	H	Holding time exceedance.
S23GWMPM04	DIETHYL PHTHALATE	10	UJ	H	Holding time exceedance.
S23GWMPM04	DIMETHYL PHTHALATE	10	UJ	H	Holding time exceedance.
S23GWMPM04	DI-N-BUTYL PHTHALATE	10	UJ	H	Holding time exceedance.
S23GWMPM04	DI-N-OCTYL PHTHALATE	10	UJ	H	Holding time exceedance.
S23GWMPM04	FLUORENE	0.21	UJ	C	Calibration non-compliance.
S23GWMPM04	FLUORENE	0.2	UJ	C	Calibration non-compliance.
S23GWMPM04	HEXACHLOROCYCLOPENTADIENE	10	UJ	H	Holding time exceedance.
S23GWMPM04	HEXACHLOROETHANE	10	UJ	H	Holding time exceedance.
S23GWMPM04	INDENO(1,2,3-CD)PYRENE	0.22	J	C	Calibration non-compliance.
S23GWMPM04	INDENO(1,2,3-CD)PYRENE	0.21	UJ	C	Calibration non-compliance.
S23GWMPM04	ISOPHORONE	10	UJ	H	Holding time exceedance.
S23GWMPM04	NAPHTHALENE	0.069	J	P	Uncertainty near the detection limit.
S23GWMPM04	NITROBENZENE	10	UJ	H	Holding time exceedance.
S23GWMPM04	N-NITROSO-DI-N-PROPYLAMINE	10	UJ	H	Holding time exceedance.
S23GWMPM04	N-NITROSODIPHENYLAMINE	10	UJ	H	Holding time exceedance.
S23GWMPM04	PENTACHLOROPHENOL	1	UJ	CR	Calibration non-compliance and surrogate recovery non-compliance.
S23GWMPM04	PHENOL	10	UJ	H	Holding time exceedance.
S23GWMPM04	TETRACHLOROETHENE	0.3	J	P	Uncertainty near the detection limit.
S23GWMPM04	TRICHLOROETHENE	0.4	J	P	Uncertainty near the detection limit.
TB061807	CHLOROETHANE	0.5	UJ	C	Calibration non-compliance.
TB061807	METHYLENE CHLORIDE	0.6	J	C	Calibration non-compliance.

TABLE 3-2

DATA QUALIFICATION AND REASONS FOR QUALIFICATIONS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT (µG/L)	VALIDATION QUALIFIER	QUALIFICATION CODE	REASON FOR QUALIFICATION
TB061807	TOLUENE	0.2	J	P	Uncertainty near the detection limit.
TB061807	TRICHLOROFLUOROMETHANE	0.5	UJ	C	Calibration non-compliance.
TB121807-01	TRICHLOROFLUOROMETHANE	0.5	UJ	C	Calibration non-compliance.

MS/MSD = Matrix spike/matrix spike duplicate

TABLE 3-3

SUMMARY OF POSITIVE DETECTIONS FOR YEAR 1 MONITORING EVENTS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

PARAMETER	Surface Water Protection Criteria[1]	Residential Volatilization Criteria[2]	Stormwater Discharge Permit Criteria[3]	ROUND 1 JUNE 18, 2006		ROUND 2 SEPTEMBER 6, 2007	ROUND 3 DECEMBER 18, 2007		ROUND 4 FEBRUARY 21, 2008
				Sample	Duplicate	Sample	Sample	Duplicate	Sample
Volatile Organics (μg/L)									
BENZENE	710	130	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 J
BROMODICHLOROMETHANE	2.3	NE	NA	0.3 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROFORM	14100	26	NA	3 J	2 J	0.5 U	0.5 U	0.5 U	0.5 U
CYCLOHEXANE	NE	NE	NA	0.5 U	0.5 U	0.1 J	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	NE	830	NA	0.3 J	0.2 J	0.3 J	0.2 J	0.5 U	0.2 J
ISOPROPYLBENZENE	NE	2800	NA	0.1 J	0.09 J	0.1 J	0.5 U	0.5 UJ	0.5 U
METHYL TERT-BUTYL ETHER	NE	21000	NA	1	0.9	0.4 J	0.6	0.6	0.7
TETRACHLOROETHENE	88	340	NA	0.3 J	0.3 J	0.4 J	0.3 J	0.2 J	0.3 J
TRICHLOROETHENE	2340	27	NA	0.4 J	0.3 J	0.5 J	0.4 J	0.3 J	0.4 J
PAHs (μg/L)									
1-METHYLNAPHTHALENE	NE	NE	NA	0.2 U	0.2 U	0.2 U	0.96 J	0.048 J	0.21 U
2-METHYLNAPHTHALENE	NE	NE	NA	0.17 J	0.16 J	0.2 U	1.1 J	0.2 UJ	0.21 UJ
4-NITROANILINE	NE	NE	NA	0.2 U	0.2 U	1 UJ	0.75 J	1.0 UR	1.0 UJ
ACENAPHTHENE	NE	NE	NA	0.2 U	0.2 U	0.2 U	0.83 J	0.029 J	0.21 U
ACENAPHTHYLENE	0.3	NE	NA	0.2 U	0.2 U	0.2 U	0.90 J	0.20 UJ	0.21 U
ANTHRACENE	1,100,000	NE	NA	0.2 U	0.2 U	0.2 U	0.92 J	0.20 UJ	0.21 U
BENZO(A)ANTHRACENE	0.3	NE	NA	0.07 U	0.07 U	0.041 U	1.0 J	0.042 UJ	0.045 U
BENZO(A)PYRENE	0.3	NE	NA	0.2 UJ	0.2 U	0.2 U	0.35 J	0.20 U	0.21 U
BENZO(B)FLUORANTHENE	0.3	NE	NA	0.08 U	0.08 U	0.075 U	0.64 J	0.078 UJ	0.082 U
BENZO(G,H,I)PERYLENE	NE	NE	NA	0.2 UJ	0.2 U	0.2 U	0.31	0.20 U	0.21 U
BENZO(K)FLUORANTHENE	0.3	NE	NA	0.2 UJ	0.2 UJ	0.2 U	0.53 J	0.20 U	0.21 U
CHRYSENE	NE	NE	NA	0.2 U	0.2 U	0.2 U	0.76 J	0.20 UJ	0.21 U
DIBENZO(A,H)ANTHRACENE	NE	NE	NA	0.2 UJ	0.2 U	0.2 U	0.14 J	0.20 U	0.21 U
FLUORANTHENE	3,700	NE	NA	0.2 U	0.2 U	0.2 U	1.1 J	0.20 UJ	0.21 U
FLUORENE	140,000	NE	NA	0.2 U	0.2 U	0.2 U	0.97 J	0.20 UJ	0.21 UJ
HEXACHLOROBENZENE	0.077	NE	NA	1 U	1 U	0.2 U	1.2 J	0.20 UJ	0.21 U
HEXACHLOROBUTADIENE	NE	NE	NA	0.2 U	0.2 U	0.48 U	0.64 J	0.099 U	0.21 U
INDENO(1,2,3-CD)PYRENE	NE	NE	NA	0.2 UJ	0.2 U	0.2 U	0.22	0.20 U	0.21 UJ
NAPHTHALENE	NE	NE	NA	0.2 U	0.2 U	0.2 U	1.0 J	0.088 J	0.21 U
PHENANTHRENE	0.3	NE	NA	0.2 U	0.2 U	0.2 U	0.98 J	0.20 UJ	0.21 U
PYRENE	110,000	NE	NA	0.2 U	0.2 U	0.2 U	0.84 J	0.20 UJ	0.21 U
PAHs, Filtered (μg/L)									
1-METHYLNAPHTHALENE	NE	NE	NA	NA	NA	NA	NA	NA	0.093 J
2-METHYLNAPHTHALENE	NE	NE	NA	NA	NA	NA	NA	NA	0.2 UJ
4-NITROANILINE	NE	NE	NA	NA	NA	NA	NA	NA	1.0 UJ
ACENAPHTHENE	NE	NE	NA	NA	NA	NA	NA	NA	0.031 J
ACENAPHTHYLENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.2 U

TABLE 3-3

SUMMARY OF POSITIVE DETECTIONS FOR YEAR 1 MONITORING EVENTS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

PARAMETER	Surface Water Protection Criteria(1)	Residential Volatilization Criteria(2)	Stormwater Discharge Permit Criteria(3)	ROUND 1 JUNE 18, 2006		ROUND 2 SEPTEMBER 6, 2007	ROUND 3 DECEMBER 18, 2007		ROUND 4 FEBRUARY 21, 2008
				Sample	Duplicate	Sample	Sample	Duplicate	Sample
PAHs, Filtered (continued) (µg/L)									
ANTHRACENE	1,100,000	NE	NA	NA	NA	NA	NA	NA	0.2 U
BENZO(A)ANTHRACENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.042 U
BENZO(A)PYRENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.2 U
BENZO(B)FLUORANTHENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.078 U
BENZO(G,H,I)PERYLENE	NE	NE	NA	NA	NA	NA	NA	NA	0.13 J
BENZO(K)FLUORANTHENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.2 U
CHRYSENE	NE	NE	NA	NA	NA	NA	NA	NA	0.2 U
DIBENZO(A,H)ANTHRACENE	NE	NE	NA	NA	NA	NA	NA	NA	0.2 U
FLUORANTHENE	3,700	NE	NA	NA	NA	NA	NA	NA	0.2 U
FLUORENE	140,000	NE	NA	NA	NA	NA	NA	NA	0.2 UJ
HEXACHLOROBENZENE	0.077	NE	NA	NA	NA	NA	NA	NA	0.2 U
HEXACHLOROBUTADIENE	NE	NE	NA	NA	NA	NA	NA	NA	0.2 U
INDENO(1,2,3-CD)PYRENE	NE	NE	NA	NA	NA	NA	NA	NA	0.22 J
NAPHTHALENE	NE	NE	NA	NA	NA	NA	NA	NA	0.069 J
PHENANTHRENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.2 U
PYRENE	110,000	NE	NA	NA	NA	NA	NA	NA	0.2 U
Inorganics, Total (µg/L)									
ALUMINUM	NE	NA	NA	473	115	322	38.1	21.8	29.4
ARSENIC	4	NA	NA	3.7 U	3 U	13.9	2.2 U	4.7 U	3.1
BARIUM	NE	NA	NA	48.2	52.4	87	55.2	53.4	55.9
CALCIUM	NUT	NA	NA	33800	35800	32000	35,500	34,700	34,300
CHROMIUM	110 (4)	NA	NA	0.94 U	0.81 U	2	0.41	0.28 U	0.38 U
COBALT	NE	NA	NA	0.84 U	0.64 U	0.26 U	0.66	0.53	0.6
COPPER	48	NA	60	3 U	3 U	4.2	0.44 U	0.22 U	0.8 U
IRON	NUT	NA	NA	9,190	11,900	70,800	9,860	10,200	4,380
LEAD	13	NA	30	2.2	9.3	8.4	2.5 U	2.2 U	1.4 U
MAGNESIUM	NUT	NA	NA	7,260	7660	7,020	7,660	7,490	7,450
MANGANESE	NE	NA	NA	661	715	845	858	815	784
NICKEL	880	NA	NA	1.1 U	0.88 U	0.41 U	0.53	0.46	0.64
POTASSIUM	NUT	NA	NA	5210	5490	5,270	5,590	5,490	5,150
SELENIUM	50	NA	NA	1.5 U	2 J	1.5 U	1.5 U	1.5 U	2.2 U
SILVER	12	NA	NA	0.46 U	0.46 U	1.5	0.46 U	0.46 U	0.54 U
SODIUM	NUT	NA	NA	46,900	49,600	52,100	53,400	52,300	50,100
VANADIUM	NE	NA	NA	1.3 U	1.4 U	3.7	0.34 U	0.29 U	0.52 U
ZINC	123	NA	200	21.3 J	22.3	47.1	22.8	20.0	26.6

TABLE 3-3

SUMMARY OF POSITIVE DETECTIONS FOR YEAR 1 MONITORING EVENTS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

PARAMETER	Surface Water Protection Criteria(1)	Residential Volatilization Criteria(2)	Stormwater Discharge Permit Criteria(3)	ROUND 1 JUNE 18, 2006		ROUND 2 SEPTEMBER 6, 2007	ROUND 3 DECEMBER 18, 2007		ROUND 4 FEBRUARY 21, 2008
				Sample	Duplicate	Sample	Sample	Duplicate	Sample
Inorganics, Filtered (μg/L)									
ALUMINUM	NE	NA	NA	20.4 J	36.7 J	21.3 J	19.0 U	19.0 U	35.4
ARSENIC	4	NA	NA	3.5 U	2.2 U	1.2 J	1.9 U	1.1 U	2.8
BARIUM	NE	NA	NA	44.6	46.4	50.1	48.9	49.6	56.8
CALCIUM	NUT	NA	NA	33,600	34,700	31,400	33,100	33,400	36,000
CHROMIUM	110 (4)	NA	NA	1.2 U	0.44 U	0.3 J	0.29	0.48	0.38 U
COBALT	NE	NA	NA	0.67 U	0.86 U	0.47 J	0.48	0.51	0.64
IRON	NUT	NA	NA	3,470	3,630	3,600	4,190	4,140	3,750
LEAD	13	NA	30	1.3 J	1.8 J	1.1 U	2.1 U	2.8 U	1.4 U
MAGNESIUM	NUT	NA	NA	7,200	7,480	6,980	7,250	7,300	8,020
MANGANESE	NE	NA	NA	645	664	708	764	770	815
NICKEL	880	NA	NA	1.1 U	0.88 U	0.78 J	1.0	0.64	0.66
POTASSIUM	NUT	NA	NA	5,090	5,390	5,320	5,360	5,390	5,390
SELENIUM	50	NA	NA	1.5 U	1.7 J	2.4 U	1.5 U	2.3 U	2.2 U
SODIUM	NUT	NA	NA	46,600	48,400	52,600	50,400	51,400	52,100
ZINC	123	NA	200	21.4 J	19.5 J	15	18.6	20.8	26
Petroleum Hydrocarbons (μg/L)									
ETPH (C09-C36)	NE	NE	2500(5)	55 J	79 U	140 J	160 U	1600 J	75 U
Petroleum Hydrocarbons, Filtered (μg/L)									
ETPH (C09-C36)	NE	NE	2500(5)	NA	NA	NA	NA	NA	75 U

1 Connecticut Remediation Standard Regulations (January 1996) and Comprehensive List of Approved Additional Polluting Substances Criteria and Alternative Criteria (October 2005).
2 Proposed Revisions to Connecticut's Remediation Standard Regulations, Volatilization Criteria (March 2003).
3 NSB-NLON General Permit for the Discharge of Stormwater Associated with Industrial Activity (DEP-PERD-GP-014, Issuance Date: October 1, 2002 and Modified Date: July 15, 2003).
4 Criterion is for hexavalent chromium
5 Criterion is for oil and grease.
BOLD Sample results that exceed a criterion are shown in bold font.
NA Not applicable.
NE Not established.
NUT Essential nutrient.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

This Year 1 Annual Groundwater Monitoring Report summarizes groundwater data collected from the underdrain metering pit at Site 23 during Rounds 1 through 4. The results are used to determine the quality of groundwater being collected and conveyed by the underdrain piping and whether constituent levels in the water pose potential risks to human health or the environment.

The Site 23 underdrain metering pit was sampled in June, September, and December 2007, and February 2008, and samples were analyzed for TCL VOCs, TCL SVOCs, TCL PAHs, TAL metals (total or dissolved), oil and grease, and ETPH. Conclusions based on evaluation of the results of these sampling events are as follows:

- All four rounds of data were similar and in general all concentrations were established Connecticut criteria with the exception of arsenic in Round 2 and seven PAHs (acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)flouranthene, benzo(k) flouranthene, hexachlorobenzene, and phenanthrene) in Round 3.

- No contaminants were detected at concentrations greater than any established Connecticut criteria during Rounds 1 and 4.

- Arsenic was detected at a concentration greater than the Surface Water Protection Criterion in an unfiltered sample during the Round 2 sampling event. However, arsenic was not detected in the filtered sample at a concentration that exceeded the criterion. Therefore, the filtered result, which is more indicative of groundwater quality, does not indicate that arsenic in groundwater presents a significant threat to human health and the environment.

- It is thought that the PAH detections in the Round 3 are related to sediment particles being present in the groundwater sample because no PAH detections concentration exceeded the criteria in the field duplicate or in the Round 4 sample, which was collected using a new sampling technique. Therefore, the PAH results in the original Round 3 sample from do not appear indicative of groundwater quality.

- Site 23 groundwater being collected and conveyed in the storm sewer system does not pose a significant current threat to human health or the environment by comparison of results to CTDEP criteria.

- Based on the Human Health Risk Assessment, under current and expected land use, Site 23 groundwater does not pose a significant threat to human health from direct exposure by construction workers or vapor intrusion into buildings. Adverse health effects are possible under hypothetical residential land use if the groundwater is used as a potable source.

4.2 RECOMMENDATIONS

The following recommendation are made for Site 23 groundwater :

- Based on the analytical results from Rounds 1 through 4 and the human health risk evaluation, implementation of institutional controls are required at Site 23 to identify the location and magnitude of groundwater contamination and to restrict extraction and use of the groundwater for residential purposes. These controls should be implemented as part of the remedies for OU 9.

- Additional monitoring is not required at Site 23 because there are no long-term monitoring requirements; however, collecting of additional rounds of data may clarify some of the anomalous results identified during Year 1.

- If additional monitoring is conducted, the analytical program should remain the same and the Round 4 sampling technique should be used to minimize impacts of suspended solids on sample results.

REFERENCES

Foster Wheeler Environmental Corporation (FWEC), 2001. Final Closeout Report for Storm Sewer Rehabilitation, Naval Submarine Base New London, Groton, Connecticut. May.

Tetra Tech, 2002. Basewide Groundwater Operable Unit Remedial Investigation Report, Naval Submarine Base New London, Groton, Connecticut. King of Prussia, Pennsylvania.

Tetra Tech NUS, Inc.(Tetra Tech), 2006. Second Five-year Review Report for CERCLA Sites at Naval Submarine Base new London, Groton, Connecticut. King of Prussia, Pennsylvania. December.

Tetra Tech, 2007a. Work Plan for Site 23 Underdrain Metering Pit Sampling, Naval Submarine Base New London, Groton, Connecticut. King of Prussia, Pennsylvania. April.

Tetra Tech, 2007b. Letter Report for June 2007 Sampling Event, Site 23 Underdrain Metering Pit, Naval Submarine Base New London, Groton, Connecticut. King of Prussia, Pennsylvania. August.

Tetra Tech, 2007c. Letter Report for September 2007 Sampling Event, Site 23 Underdrain Metering Pit, Naval Submarine Base New London, Groton, Connecticut. King of Prussia, Pennsylvania. October.

Tetra Tech, 2008. Letter Report for December 2007 Sampling Event, Site 23 Underdrain Metering Pit, Naval Submarine Base New London, Groton, Connecticut. King of Prussia, Pennsylvania. February.

Tetra Tech, 2008a. Human Health Risk Assessment Memo - Site 23 Groundwater, Site 23 Underdrain Metering Pit, Naval Submarine Base New London, Groton, Connecticut, May 19.

Tetra Tech, 2008b. Memorandum Regarding Vapor Intrusion Evaluation for Groundwater at Operable Unit 9, Site 23 Underdrain Metering Pit, Naval Submarine Base New London, Groton, Connecticut. May 30.

USEPA, 1989 - U.S. EPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses. February.

USEPA, 1996 - U.S. EPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses. December.

USEPA, 2001 - U.S. EPA Contract Laboratory Program National Functional Guidelines for Low Concentration Organic Data Review. June.

USEPA, 2008. EPA Comments on the Basewide Groundwater Vapor Intrusion Analyses. Email from Kymberlee Kecker of USEPA Region I to Corey Rich of Tetra Tech NUS, Inc. April 24.

APPENDICES

APPENDIX A

FIELD FORMS

APPENDIX A.1

ROUND 1 – FIELD FORMS

MON 6-18-07 SITE 23 UNDERDRAIN METERING PIT MANHOLE

Work continued from Page

0650 Hrs - LEAVE DAVISVILLE FOR NEW LONDON & PICK UP ICE
0745 Hrs - ARRIVE @ PASS & ID NEW LONDON (NSB NLON)
0810 Hrs - CHECK IN W/ R. CONANT
• took A RIDE OVER to MANHOLE W/ RC
0830 Hrs - RETURN R. CONANT to his OFFICE
0840 Hrs - RETURN to MANHOLE SITE 23
0900 Hrs - Collect TB 061807 @ 0900 Hrs
Cali. HORIBA SN : 4063029
TUB. METER LA MOTTE 2020 - 3594 - 3502 (SN)
CARRY EQ & SAMPLE CONTAINERS to MANHOLE
0930 Hrs - BEGIN SAMPLING MANHOLE ID# = 523GWMPM01
AND DUP = FD-061807
WATER QUALITY :
pH = 6.18 SU, Cond = 0.709 mS/cm, DO = 9.00 mg/L, TEMP 16.63 °C
ORP = 45 mV TURB = 55.6 NTUs Orange Percipitate
1205 - LEAVE NSB NLON - PICK UP ADDITIONAL ICE
1330 Hrs - ARRIVE @ DAVISVILLE SITE -
• PREP SAMPLES FOR SHIPMENT to KATAHDIN
ATTN. ANDREA COLBY VIA FED EX AB# 831948770933
1700 Hrs - DELIVERED SAMPLES to FED. EX (SEE COC # 4779)

END

Work continued to Page

SIGNATURE [signature] DATE 6-18-07

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE

Tetra Tech NUS, Inc.

DOCUMENTATION OF FIELD CALIBRATION

PROJECT NAME : NSB NEW LONDON

SITE NAME: 23

PROJECT No.: 112G00777

INSTRUMENT NAME/MODEL: U-22

MANUFACTURER: Horiba

SERIAL NUMBER: 4063029

Date of Calibration	Person Performing Calibration	INITIAL READINGS						FINAL READINGS						Calibration Standard (Lot No.)	Remarks and Comments
		PH	COND	TURB	DO	TEMP	SAL	PH	COND	TURB	DO	TEMP	SAL		
6/18/07	TR	4.00	4.62	NA	7.52	22.83	NA	4.60	4.49	NA	*7.47	22.86	NG	5585	Exp. Date 2/1/08

* PER DISCUSSION WITH T. ROJAHN ON 8/16/07, THE ASTERISK (*) INDICATES THAT THE FINAL CALIBRATION READING FOR DO SHOULD HAVE BEEN HIGHER (CLOSE TO 8.4) BASED ON THE TEMPERATURE OF THE CALIBRATION SOLUTION. THE LOWER READING INDICATES THAT THE DO PROBE MAY NOT BE FUNCTIONING PROPERLY. C. RICH 8/16/07

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : NSB NEW LONDON

SITE NAME: 23

PROJECT No.: 112G00777

INSTRUMENT NAME/MODEL: LAMOTTE 2020

MANUFACTURER: LAMOTTE

SERIAL NUMBER: 3594 - 3502

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	0 NTUs		10 NTUs		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		
6/18/07	SAME	TR	0.00	0.00	9.78	10.00	0 = P676590	EXP. DATE 2/08
							10 = P674931	" " "

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSB NEW LONDON
Project No.: 112GN00777

[] Stream
[] Spring
[] Pond
[] Lake
[X] Other: Manhole - monitoring Pit
[] QA Sample Type:

Sample ID No.: S23GWMPM01
Sample Location: Site 23
Sampled By: T. Rojahn
C.O.C. No.: 4779

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

		Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	Other NA
Date:	6/18/2007								
Time:	9:30								
Depth:	NA	clear w/ Orange precip.	6.18	0.709	16.63	55.6	9.00	NA	NA
Method:	S.S. Beaker								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Volatiles	$4^0C/HCl$	(3) 40 ml VOA Vial	Yes
TCL SVOCS, PAHS & SIM	4^0C	(2) 1 L Glass Amber	Yes
Total Oil and Grease	$4^0C/H_2SO_4$	(2) 1 L Glass Amber	Yes
ETPH	4^0C	(2) 1 L Glass Amber	Yes
Total TAL Metals	$4^0C/HNO_3$	(1) 500 ml HDPE	Yes
Dissolved TAL Metals	$4^0C/HNO_3$	(1) 500 ml HDPE	Yes

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
YES	FD-061807

Signature(s): Terry Rojahn

TETRA TECH NUS, INC.

CHAIN OF CUSTODY | NUMBER 4779 | PAGE 1 OF 1

PROJECT NO: 112G00777	FACILITY: NSB NEW LONDON
PROJECT MANAGER: COREY RICH	PHONE NUMBER: 412 921-8984
FIELD OPERATIONS LEADER: TERRY ROJAHN	PHONE NUMBER: 412 921-8857
CARRIER/WAYBILL NUMBER: FED EX AB # 831948770933	
LABORATORY NAME AND CONTACT: KATAHDIN / A. COLBY	
ADDRESS: 600 TECHNOLOGY WAY	
CITY, STATE: SCARBOROUGH, ME 04074	

SAMPLERS (SIGNATURE): Terry Rojahn

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR 2007	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	VOCs 40ml Glass Vials (G, 4°C/HCL)	TCL SVOCs, PAHs & SIM 1L Amber (G, 4°C)	Total Oil & Grease 1L Amber (G, 4°C/H2SO4)	ETPH 1L Amber (G, 4°C)	Total TAL Metals 500ml HDPE (P, 4°C/HNO3)	Dissolved TAL Metals 500ml HDPE (P, 4°C/HNO3)			COMMENTS
6/18	0900	TB061807	QC ~~MANHOLE~~	–	–	QC	G	2	2								TRIP BLANK
6/18	0930	S23GWMPM01	MANHOLE	–	–	GW	G	31	9	6	6	6	2	2			RUN MS/MSD
6/18	0000	FD-061807	MANHOLE	–	–	GW	G	11	3	2	2	2	1	1			

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY Terry Rojahn	6-18-07	1700	1. RECEIVED BY FEDERAL EXPRESS	6-18-07	1700
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

APPENDIX A.2

ROUND 2 – FIELD FORMS

TITLE NSB-LON ROUND 2 **PROJECT NO.** 112G00777 **BOOK NO.** 1398

THURS 9-6-07 SITE 23 - UNDERDRAIN METERING PIT MANHOLE

Work continued from Page

10:30 Hrs - ARRIVE @ Davisville Trailer - calibrate meters pick up disposable supplies & equipment (s.s. beaker, pick buckets, etc); prep. SUV for sewer sampling
11:50 Hrs - LEAVE DAVISVILLE FOR NEW LONDON
12:45 Hrs - Purchase ICE
13:05 Hrs - Pick up sample containers & check in w/ D. Conant
13:15 Hrs - Arrive @ MANHOLE LOCATION
13:25 Hrs - Start Sampling
14:55 Hrs - Finish Clean up @ manhole & Report to D. Conant & C. Rich via phone.
15:00 Hrs - LEAVE NSB-LON FOR Davisville Trailer to process samples FOR FED EX shipment.
16:05 Hrs - ARRIVE @ DAVISVILLE TRAILER
Perform sample handling & Package samples on COC # 4253 FOR shipment to Katahdin Analytical on FED. EX. Airbill # 8545 6732 9529
1835 Hrs - Drop off samples @ FED. EX.

END

SCIENTIFIC BINDERY PRODUCTIONS CHICAGO 60605 MADE IN USA

Work continued to Page

SIGNATURE [signature] DATE 9-6-07

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE

TETRA TECH NUS, INC.

CHAIN OF CUSTODY | NUMBER 4253 | PAGE 1 OF 1

PROJECT NO: 112G00777	FACILITY: NSB NEW LONDON	PROJECT MANAGER: COREY RICH
PHONE NUMBER: (412) 921-8984	LABORATORY NAME AND CONTACT: KATAHDIN / ANDREA COLBY	
SAMPLERS (SIGNATURE): Terry Rojahn	FIELD OPERATIONS LEADER: TERRY ROJAHN	PHONE NUMBER: (412) 921-8857
ADDRESS: 600 TECHNOLOGY WAY	CARRIER/WAYBILL NUMBER: AB # 8545 6732 9529	CITY, STATE: SCARBOROUGH, ME 04074

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

										VOCs 40ml Vials	TCL SVOCs, PAHs & SIM 1L AMBER	Total Oil & Grease 1L AMBER	ETPH 1L AMBER	Total TAL METALS 500ml HDPE	Dissolved TAL METALS 500ml HDPE			
								CONTAINER TYPE PLASTIC (P) or GLASS (G)		G	G	G	G	P	P			
								PRESERVATIVE USED		4°C / HCl	4°C	H2SO4 / 4°C	4°C	HNO3 / 4°C	HNO3 / 4°C			
DATE YEAR 2007	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS									COMMENTS
9/6	1315	TB090607	QC	—	—	QC	G	2										TRIP BLANK
9/6	1325	S23GWMPM02	MAN HOLE	—	—	GW	G	31		9	6	6	6	2	2			RUN MS/MSD

1. RELINQUISHED BY: Terry Rojahn	DATE: 9-6-07	TIME: 1900	1. RECEIVED BY: FEDERAL EXPRESS	DATE: 9-6-07	TIME: 1900
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name:	NSB NEW LONDON	Sample ID No.:	S23GWMPM02
Project No.:	112G00777	Sample Location:	Site 23
		Sampled By:	T. Rojahn
		C.O.C. No.:	4253

[] Stream
[] Spring
[] Pond
[] Lake
[X] Other: Manhole - Monitoring Pit
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	~~Other~~ ORP mV ~~NA~~
Date: 9-6-07 Time: 1325 Depth: NA Method: S.S. Beaker	CLEAR w/ ORANGE PERCIP.	6.61	5.8	17.3	26	4.7	0.0	15

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Volatiles	$4^0C/HCl$	3 x (3) 40 ml VOA Vial	Yes
TCL SVOCS, PAHS & SIM	4^0C	3 x (2) 1 L Glass Amber	Yes
Total Oil and Grease	$4^0C/H_2SO_4$	3 x (2) 1 L Glass Amber	Yes
ETPH	4^0C	3 x (2) 1 L Glass Amber	Yes
Total TAL Metals	$4^0C/HNO_3$	2 x (1) 500 ml HDPE	Yes
Dissolved TAL Metals	$4^0C/HNO_3$	2 x (1) 500 ml HDPE	Yes

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD YES

Duplicate ID No.:

Signature(s):

T. Rojahn

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : NSB NEW LONDON

SITE NAME: 23

PROJECT No.: 112G00777

INSTRUMENT NAME/MODEL: LAMOTTE 2020

MANUFACTURER: LAMOTTE

SERIAL NUMBER: 2239-0501

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	0 NTUs		10 NUTs		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		
9-6-07	SAME	TK	0.00	0.00	9.83	10.00	0 =	NA EXP 7/1/08
↓	↓	↓					10 =	GFS #8184-P780246
								EXP. 7/2008

Tetra Tech NUS, Inc.

DOCUMENTATION OF FIELD CALIBRATION

PROJECT NAME : NSB NEW LONDON

SITE NAME: 23

PROJECT No.: 112G00777

INSTRUMENT NAME/MODEL: U-22

MANUFACTURER: Horiba

SERIAL NUMBER: U00520X

Date of Calibration	Person Performing Calibration	INITIAL READINGS						FINAL READINGS						Calibration Standard (Lot No.)	Remarks and Comments
		PH s.u.	COND mS/cm	TURB NTU	DO mg/L	TEMP °C	SAL	PH	COND	TURB	DO	TEMP	SAL		
9/6/07	T.R.	4.79	4.60	1	9.3	21.9	NA	4.00	4.50	0	8.90	21.9	NA	5585	Exp 2-1-08

APPENDIX A.3

ROUND 3 – FIELD FORMS

Work continued from Page WEATHER SUNNY 25-33°F - KEITH SIMPSON

— 12.17.07 PM TRAVEL TO GROTON, CT —

0635 CAL. HORIBA & LaMOTTE TO PASS & ID

0655 MEET DICK CONANT SIGN IN/PICK-UP PASS TO MAN HOLE @ SITE 23 CLEAR ICE & SNOW FROM MAN HOLE AREA. TRANSPORT BOTTLES & EQ. TO MH & START

0810 SAMPLING (SEE Pg 122)

1100 COMPLETE SAMPLING CLEAN-UP & CLOSE MH TO ENVIRONMENTAL & LET DICK KNOW SAMPLING IS COMPLETE. TO 2LMW36B - ABANDON MW - AREA SNOW COVERED COULD NOT CHECK PATCH JOB

1130 TO GAS STATION & PICK-UP ICE, TO HOTEL PACK SAMPLES & EQ. LUNCH & CHECK-OUT

1330 OF HOTEL TO FED EX
AB # 8631 2568 3070

1440 GAS RENTAL CAR TO T.F. GREEN AIRPORT PAPER WORK, TO PGH/HOME

SCIENTIFIC BINDERY PRODUCTIONS CHICAGO 60605 MADE IN USA

Work continued to Page

SIGNATURE Keith S. Simpson DATE 12.19.07

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE

BOOK # 1398

12.18.07

KEITH SIMPSON

SAMPLED 523GW MPM-03 @ 0840
+ COLLECTED DUP & MS/MSD

PH 5.67 S.C. 0.594 TEMP 13.2

TURB 3.4 DO 4.15 SAL % 0

ORP +52

EST. FLOW RATE 6 GPM

TETRA TECH NUS, INC. — CHAIN OF CUSTODY — NUMBER 4435 — PAGE 1 OF 1

PROJECT NO: CTO 73 1126-00777	FACILITY: NSB-NLON	PROJECT MANAGER: COREY RICH	PHONE NUMBER: 412 921 8984
LABORATORY NAME AND CONTACT: KATAHDIN, A. COLBY		FIELD OPERATIONS LEADER: KEITH SIMPSON	PHONE NUMBER: 412 921 8131
SAMPLERS (SIGNATURE): Keith S. Simpson		ADDRESS: 600 TECHNOLOGY WAY	
CARRIER/WAYBILL NUMBER: FEDEX 8631 2568 3070		CITY, STATE: SCARBOROUGH, ME 04074	

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

SITE 23 UNDERDRAIN METER PIT ROUND 3

DATE YEAR 2007	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	VOC 40 ML GLASS (G, HCL)	TCL SVOC, PAHs + SIM - AMBER QT (G, 4°C)	TOTAL OIL + GREASE AMBER QT (G, H2SO4 4°C)	ETPH, AMBER GLASS (G, 4°C)	TAL METALS 500 ML (P, HNO3)	DISSOLVED TAL METALS 500 ML (P, HNO3)			COMMENTS
12/18	0730	TB121807-01	QC	—	—	QC	G	2	2	—	—	—	—	—			
12/18	0840	S23GWMPM-03	MAN HOLE	—	—	GW	↓	31	9	6	6	6	2	2			RUN ALSO MS/MSD
12/18	0000	FD121807-01	↓	—	—	↓	↓	11	3	2	2	2	1	1			

1. RELINQUISHED BY: Keith S. Simpson	DATE 12.18.07	TIME 1430	1. RECEIVED BY: FEDEX	DATE 12.18.07	TIME 1430
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSB NEW LONDON
Project No.: 112G00777

ROUND 3

[] Stream
[] Spring
[] Pond
[] Lake
[X] Other: Manhole - Monitoring Pit
[] QA Sample Type:

Sample ID No.: S23GWMPM03
Sample Location: Site 23
Sampled By: K. Simpson
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	~~Other~~ ORP NA
Date: 12.18.07 / Time: 0840 / Depth: NA / Method: S.S. Beaker	VERY LT. CLOUDY	5.67	0.544	13.2	3.4	4.15	0	+52

SAMPLE COLLECTION INFORMATION

Analysis	Preservative	Container Requirements	Collected
Volatiles	4°C/HCl	9+ (3) 40 ml VOA Vial	Yes
TCL SVOCS, PAHS & SIM	4°C	6+ (2) 1 L Glass Amber	Yes
Total Oil and Grease	4°C/H_2SO_4	6+ (2) 1 L Glass Amber	Yes
ETPH	4°C	6+ (2) 1 L Glass Amber	Yes
Total TAL Metals	4°C/HNO_3	2+ (1) 500 ml HDPE	Yes
Dissolved TAL Metals	4°C/HNO_3	2+ (1) 500 ml HDPE	Yes
		4X VOL FOR QA & SAMPLE	

OBSERVATIONS / NOTES

SAMPLE - CLEAR WITH TRACE ORANGE/RUST COLOR FLOC. NO ODOR

MAP

EST. FLOW RATE 6GPM

Circle if Applicable:

MS/MSD YES

Duplicate ID No.: YES FD 121807-01

Signature(s): [signature]

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : NSB NEW LONDON

SITE NAME: 23 ROUND 3

PROJECT No.: 112G00777

INSTRUMENT NAME/MODEL: LAMOTTE 2020 E

MANUFACTURER: LAMOTTE

SERIAL NUMBER: SN - ME 12279

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	0 NTUs		10 NUTs		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		
12.18.07	12279	K. SIMPSON	0.2	0.0	10.0	10.0	0 = P7 81115	EXP. 9/2008
							10 = P6 77870	EXP 8/2008

RENTED FROM
EAGLE INSTRUMENTS
PO # 1027271

Tetra Tech NUS, Inc.

DOCUMENTATION OF FIELD CALIBRATION

PROJECT NAME : NSB NEW LONDON
SITE NAME: 23 ROUND 3
PROJECT No.: 112G00777

INSTRUMENT NAME/MODEL: U-22
MANUFACTURER: Horiba
SERIAL NUMBER: 701025

Date of Calibration	Person Performing Calibration	INITIAL READINGS						FINAL READINGS						Calibration Standard (Lot No.)	Remarks and Comments
		PH SU	COND MS/CM	TURB NTU	DO Mg/L	TEMP oC	SAL %	PH	COND	TURB	DO	TEMP	SAL		
12.18.07	K. SIMPSON	3.99	4.30	0	7.73	25.4	0.2	4.00	4.49	0	7.70	25.4	0.1	5741	EXP 5/2008

RENTED FROM
EAGLE INSTRUMENTS
PO# 1027271

APPENDIX A.4

ROUND 4 – FIELD FORMS

WED 2-20-08

Work continued from Page

1100 Hrs - ARRIVE PIT AIRPORT
1400 Hrs - ARRIVE @ DAVISVILLE TRAILER
• Pick up sampling EQ. Buckets, Pick, etc.
(1) PACKAGE → • PACKAGE PRINTER FOR SHIPMENT to Hotel @ Great Lakes site on FED EX AB
(3) PACKAGES → • PACKAGE EQ FOR Davisville to SHIP to OFFICE (S. Anderson) on FED EX AB
1800 Hrs - DROP OFF EQ @ FED. EX
1910 Hrs - ARRIVE @ GROTON Hotel - PAPERWORK

END

Work continued to Page

SIGNATURE [signature] DATE 2-20-08

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE

THURS. 2-21-08

Work continued from Page

0650 HRS - ARRIVE @ PASS & ID - CALL D. Comant (DC)
- Wait FOR DC
- obtain PASS - And PAPERWORK FOR Long TERM PASS

0730 HRS - ARRIVE @ DCs OFFICE
- CHECK OUT Bottles RECEIVED
- CALIBRATE METERS (HORIBA U-22 & LA MOTTE 2020)
- DC & TR FILL OUT PAPERWORK FOR Long TERM PASS

0830 HRS - ARRIVE @ PIER 1 - take PHOTOS OF AREA tobe sampled FOR SEDIMENT

0900 HRS - ARRIVE @ SITE 23 - Collect TRIP BLANK TB022108-01 @ 0900 HRS

0925 HRS - Start Collecting sample S23GWMPM04

1130 HRS - DROP DC OFF @ BLDG 439

1205 HRS - PURCHASE STRAPPING TAPE @ THE MAIL ROOM

1310 HRS - ARRIVE @ DAVISVILLE TRAILER
- DROP OFF Tools
- PACKAGE SAMPLES ON COC # 4719 FOR SHIPMENT to Katahdin LAB ON FED. EX AB# 8631 3887 8469
- PACKAGE EQ FOR SHIPMENT to US ENVIRONMENTAL RENTAL CORP ON FED EX AB# 8631 3887 8458

1450 HRS - DROP OFF SAMPLES & RENTAL EQ @ FED. EX.

1510 HRS - ARRIVE @ PROVIDENCE AIRPORT

1605 HRS - Catch Flight

1735 HRS - ARRIVE PIT AIRPORT

1840 HRS - ARRIVE Home

END

Work continued to Page

SIGNATURE [signature] DATE 2/21/08

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE

Tetra Tech NUS, Inc.

DOCUMENTATION OF FIELD CALIBRATION

PROJECT NAME : NSB NEW LONDON

SITE NAME: 23

PROJECT No.: 112G00777

INSTRUMENT NAME/MODEL: U-22

MANUFACTURER: Horiba

SERIAL NUMBER: 3073010

Date of Calibration	Person Performing Calibration	INITIAL READINGS						FINAL READINGS						Calibration Standard (Lot No.)	Remarks and Comments
		PH	COND	TURB	DO	TEMP	SAL	PH	COND	TURB	DO	TEMP	SAL		
2/21	TR	4.00	4.48	-	10.53	20.23	-	4.00	4.48	0.0	9.01	20.24	-	5843	Exp 7/31/08

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : NSB NEW LONDON

INSTRUMENT NAME/MODEL: LAMOTTE 2020

SITE NAME: 23

MANUFACTURER: LAMOTTE

PROJECT No.: 112G00777

SERIAL NUMBER: 5915-2405

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	0 NTUs		10 NUTs		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		
2/21	SAME	TR	0.00	0.00	10.09	10.00	0 =	P676590 EXP 11/08
							10 =	P784629 5/09

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSB NEW LONDON
Project No.: 112G00777

[] Stream
[] Spring
[] Pond
[] Lake
[X] Other: Manhole - Monitoring Pit
[] QA Sample Type:

Sample ID No.: S23GWMPM04
Sample Location: Site 23
Sampled By: T. Rojahn
C.O.C. No.: 4719

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	Other ORP NA mV
Date: 2-21-08 Time: 0925 Depth: NA Method: S.S. Beaker	CLEAR	6.33	0.648	11.76	2.43	18.26	–	40

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Volatiles	4^{0}C/HCl	3x (3) 40 ml VOA Vial	Yes
TCL SVOCS, PAHS & SIM	4^{0}C	3x (2) 1 L Glass Amber	Yes
Total Oil and Grease	4^{0}C/H_2SO_4	3x (2) 1 L Glass Amber	Yes
ETPH	4^{0}C	3x (2) 1 L Glass Amber	Yes
Total TAL Metals	4^{0}C/HNO_3	2x (1) 500 ml HDPE	Yes
Dissolved TAL Metals	4^{0}C/HNO_3	2x (1) 500 ml HDPE	Yes
Dissolved PAHs	4^{0}C	3x (2) 1 L Glass Amber	Yes
Dissolved ETPH	4^{0}C	3x (2) 1 L Glass Amber	Yes

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
YES	—

Signature(s): T. Rojahn

TETRA TECH NUS, INC. CHAIN OF CUSTODY NUMBER 4719 PAGE 1 OF 1

PROJECT NO: 112G00777	FACILITY: NSB-NEW LONDON	PROJECT MANAGER: COREY RICH	PHONE NUMBER: (412) 921-8984	LABORATORY NAME AND CONTACT: KATAHDIN / A. COLBY
SAMPLERS (SIGNATURE): Terry Rojahn		FIELD OPERATIONS LEADER: T. ROJAHN	PHONE NUMBER: (412) 921-8857	ADDRESS: 600 TECHNOLOGY WAY
		CARRIER/WAYBILL NUMBER: FED. EX. AB # 8631 3887 8469		CITY, STATE: SCARBOROUGH, ME 04074

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

SITE 23
ROUND 4

CONTAINER TYPE PLASTIC (P) or GLASS (G)										G	G	G	G	P	P	G	G	
PRESERVATIVE USED										4°C/HCl	4°C	4°C/H2SO4	4°C	4°C/HNO3	4°C/HNO3	4°C	4°C	
DATE 2008 YEAR	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS	VOCS 40ml Vials	TCL SVOCS, PAHS & SIM 1L AMBER	Total Oil & GREASE 1L Amber	ETPH 1L Amber	Total METALS 500 HDPE	DISSOLVED TOTAL Metals 500 HDPE	PAHS (Dissolved) 1L Amber	ETPH (Dissolved) 1L Amber	COMMENTS
2/21	0900	TB022108-01	QC	-	-	QC	G	2		2								TRIP BLANK
2/21	0925	S23GWMPM04	MAN HOLE	-	-	GW	G	43		9	6	6	6	2	*2	*6	*6	RUN MS/MSD

1. RELINQUISHED BY: Terry Rojahn	DATE: 2/21/08	TIME: 1500	1. RECEIVED BY: FEDERAL EXPRESS	DATE: 2/21/08	TIME: 1500
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS * FIELD Filtered

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

APPENDIX B

ROUND 4 DATA VALIDATION LETTER

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**C. RICH**	**DATE:**	**APRIL 16, 2008**
FROM:	**MATTHEW D. KRAUS**	**COPIES:**	**DV FILE**

SUBJECT: **INORGANIC/ORGANIC DATA VALIDATION – TAL METALS /VOC/SVOC/PAH/TPH/HEM**
NSB NEW LONDON – CTO 0073
SDG – SB0921

SAMPLES: 2/Aqueous/

S23GWMPM04 TB022108-01

Overview

The sample set for CTO 0073, NSB New London, SDG: SB0921, consists of one aqueous environmental sample and one field quality control blank.

Both samples were analyzed for target compound list (TCL) volatile organic compounds (VOCs). Sample S23GWMPM04 was also analyzed for semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), total and dissolved total petroleum hydrocarbons (TPH), total and dissolved target analyte list (TAL) metals and oil and grease: hexane extractable materials (O&G:HEM). The samples were collected by Tetra Tech NUS on February 21, 2008 and analyzed by Katahdin Analytical under Naval Facilities Engineering Service Center (NFESC) Quality Assurance/Quality Control (QA/QC) criteria. The VOC, SVOC/PAH, TPH, metals, mercury and O&G: HEM analyses were conducted in accordance with SW-846 methods OLC03.2, 8270C, CT-ETPH, 6010B, 7470A and EPA method 1664, respectively. Gas chromatography/Mass Spectrometer (GC/MS), GC/MS with a Selective Ion Monitor (SIM), GC/Flame Ionization Detector (FID), Inductively Couple Plasma-Atomic Emission Spectrometer (ICP-AES), Cold Vapor Atomic Absorption (CVAA) and gravimetric instrumentation and methodologies were used to evaluate VOCs/SVOCs, PAHs, TPHs, metals, mercury, and O&G: HEM, respectively.

Data were evaluated based on the following parameters:

* • Data Completeness
• Holding Times
* • GC/MS Instrument Tuning
• Initial and Continuing Calibration Recoveries
* • Laboratory Method/Preparation Blank Analyses
• Matrix Spike Recoveries
• Laboratory Control Sample Recoveries
* • ICP Serial Dilution
• Surrogate Recoveries
* • Internal Standard Recoveries
• Detection Limits
* • Sample Quantitation

* - All quality control criteria were met for this parameter.

VOC

The percent recoveries (%Rs) reported for the surrogate chloroethane-D5 were greater than the upper quality control limit (126%) for all samples. No validation action was required because all results associated with this surrogate were reported as non-detected.

SVOC

The %Rs of the acid extractable SVOC surrogates 2-fluorophenol, phenol-D6 and 2,4,6-tribromophenol were less than the respective lowest quality control limits for sample S23GWMPM04 on instrument GCMS-R on 02/07/08. The %R's of 2-fluorophenol and phenol-D6 were less than 10%. According to the case narrative, sample S23GWMPM04 was re-extracted for SVOCs six days beyond on the holding time and re-analyzed as instructed by the client. A re-analysis of sample S23GWMPM04 for SVOCs occurred on 03/06/08. All SVOC sample results are reported from the 03/06/08 analysis because using the 02/29/08 data would result in the rejection of acid extractable compound data. The non-detected results reported for SVOCs results are qualified as estimated, "UJ", due to extraction holding time exceedance.

The laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) %Rs for 3,3'-dichlorobenzidine were greater than the upper quality control for WG48980-LCS and WG48980-LCSD on instrument GCMS-R at 11:59 on 03/06/08 affecting sample S23GWMPM04. No data was qualified because the affected 3,3'-dichlorobenzidine result was reported as non-detected.

The LCS %R for bis(2-chloroethoxy)methane was greater than the upper quality control for WG48980-LCS on instrument GCMS-R at 11:59 on 03/06/08 affecting sample S23GWMPM04. No data was qualified because the affected bis(2-chloroethoxy)methane result was reported as non-detected.

The matrix spike (MS) and matrix spike duplicate analyses (MSD) of sample S23GWMPM04 yielded %Rs for 2,4-dimethylphenol, 2,4-dichlorophenol and 2,4,6-trichlorophenol that were less than respective lower quality control limits but greater than 10%. The affected non-detected results reported for the aforementioned compounds were qualified as estimated, "UJ".

The MSD analysis of sample S23GWMPM04 yielded a %R for 3&4-methylphenol that was less than the lower quality control limit but greater than 10%. The MS analysis of sample S23GWMPM04 yielded a %R for 3&4-methylphenol that was within quality control limits. The affected non-detected results reported for the aforementioned compounds were qualified as estimated, "UJ".

PAH

The continuing calibration percent differences (%Ds) for 2-methynaphthalene, acenaphthene, fluorene, 4-nitroaniline, pentachlorophenol, benzo(b)fluoranthene and benzo(a)pyrene were outside of the ±25% criteria on instrument GCMS-U at 12:07 on 03/05/08. No environmental data was qualified because only the laboratory control sample (LCS) WG48714-LCS was affected.

The continuing calibration %Ds for 2-methylnaphthalene, fluorene, 4-nitroaniline, pentachlorophenol, bis(2-ethylhexyl)phthalate, and indeno(1,2,3-cd)pyrene were outside of the ±25% criteria on instrument GCMS-U at 09:08 on 03/06/08 affecting the total and dissolved analyses of sample S23GWMPM04. The positive and non-detected results reported for the aforementioned compounds were qualified as estimated, "J" or "UJ", respectively, except for the affected dissolved pentachlorophenol result which was qualified as rejected, "UR", due to surrogate noncompliance.

The initial calibration percent relative standard deviation (%RSD) for 4-nitroaniline on instrument GCMS-U on 03/08/08 was greater than 30%. No environmental data was qualified because only the PAH method blank was affected.

Six compounds yielded %Ds outside of the ±25% criteria on instrument GCMS-U at 10:40 on 03/11/08. No environmental data was qualified because only the PAH method blank was affected.

The %R of the surrogate 2,4-dibromophenol was less than the lower quality control limit but greater than 10% for the total PAH analysis of sample S23GWMPM04. The total non-detected result reported for pentachlorophenol was qualified as estimated, "UJ".

The %R of the surrogate 2,4-dibromophenol was less than 10% for the dissolved PAH analysis of sample S23GWMPM04. The dissolved non-detected result reported for pentachlorophenol was qualified as rejected, "UR".

The %R for 2,4-dibromophenol was less than 10% in all MS and MSD analyses. No validation action was taken.

The MS and MSD %Rs for dissolved pentachlorophenol from sample S23GWMPM-04 were less than the lower quality control limit and greater than 10%. No validation action was taken because the affected pentachlorophenol result was previously qualified due to a more severe noncompliance.

The PAH MS/MSD filtered relative percent difference (RPD) for hexachlorobutadiene was greater than the upper quality control limit. No action was taken because the %Rs for both the MS and MSD for hexachlorobutadiene were acceptable.

Metals

The following contaminants were detected in laboratory method/preparation blanks at the following maximum concentrations:

Analyte	Maximum Concentration	Action Level
Barium	0.59 µg/L	2.95 µg/L
Cadmium	0.19 µg/L	0.95 µg/L
Iron	7.21 µg/L	36.0 µg/L
Magnesium	8.64 µg/L	43.2 µg/L
Sodium [1]	307 µg/L	1535 µg/L
Thallium	14.2 µg/L	71.0 µg/L
Zinc [1]	1.80 µg/L	9.00 µg/L

[1] Maximum concentration present in a laboratory method preparation blank affecting all samples.

An action level of five times the maximum contaminant level has been used to evaluate sample data for blank contamination. Sample aliquot and dilution factors, if applicable, were taken into consideration when evaluating for blank contamination. No data was qualified due to laboratory blank contamination.

Detection Limits

The required quantitation limit (RQL) listed in the laboratory SOW of 1.0 mg/L for O&G:HEM was not met by the laboratory which reported an O&G: HEM method detection limit (MDL) of 1.2 mg/L.

Notes

Several results were qualified as estimated, "J", due to uncertainty near the detection limit.

The %Rs for the surrogate 2-fluorophenol were less than the lower quality control limit but greater than 10% the matrix spike (MS) and matrix spike duplicate (MSD) analysis of sample S23GWMPM04. No data was qualified because no environmental samples were directly affected.

The compounds bis(2-ethylhexyl)phthalate, 4-nitroaniline, hexachlorobenzene, hexachlorobutadiene and pentachlorophenol were analyzed and reported with the PAHs by the laboratory instead of a SVOCs as listed in the laboratory scope-of-work (SOW). The laboratory used GC/MS SIM instrumentation in order to achieve detection limits required in the laboratory SOW. The required detection limits listed for bis(2-ethylhexyl)phthalate, 4-nitroaniline, hexachlorobenzene, hexachlorobutadiene and pentachlorophenol in the laboratory SOW were achieved.

Several dissolved PAH compound and dissolved metal analyte results were slightly greater than corresponding total PAH and total metal analyte results which is theoretically impossible.

The Practical Quantitation Limit (PQL) standard analyzed on 02/27/08 at 14:26 yielded a %R for barium that was above quality control limits. No data was qualified because the PQL with the noncompliant barium %R was not associated with the environmental samples contained in this SDG.

Executive Summary

Laboratory Performance: Several SVOC compound results were qualified due to calibration noncompliance. All SVOC results were qualified as estimated due to holding time exceedance.

Other Factors Affecting Data Quality: The dissolved pentachlorophenol result was qualified as rejected due to surrogate recovery noncompliance.

The data for these analyses were reviewed with reference to the "USEPA CLP National Functional Guidelines for Low Concentration Organic Data Review", June 2001, "USEPA Region 1 Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses", December 1996, "USEPA Region 1 Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses", June 1988, and the (DOD) QSM document entitled "Quality Systems Manual (QSM) for Environmental Laboratories" (January 2006).

The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the (DOD) QSM Guidelines."

Tetra Tech NUS
Matthew D. Kraus
Environmental Chemist

Tetra Tech NUS
Joseph A. Samchuck
Quality Assurance Officer
Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as reported by the Laboratory
3. Appendix C – Regional Worksheets
4. Appendix D - Support Documentation

APPENDIX A

QUALIFIED ANALYTICAL RESULTS

Data Validation Qualifier Codes:

A	= Lab Blank Contamination
B	= Field Blank Contamination
C	= Calibration Noncompliance (e.g. %RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01	= GC/MS Tuning Noncompliance
D	= MS/MSD Recovery Noncompliance
E	= LCS/LCSD Recovery Noncompliance
F	= Laboratory Duplicate Imprecision
G	= Field Duplicate Imprecision
H	= Holding Time Exceedance
I	= ICP Serial Dilution Noncompliance
J	= GFAA PDS – GFAA MSA's r <0.995 / ICP PDS Recovery Noncompliance
K	= IPC Interference – included ICS %R Noncompliance
L	= Instrument Calibration Range Exceedance
M	= Sample Preservation Noncompliance
N	= Internal Standard Noncompliance
N01	= Internal Standard Recovery Noncompliance Dioxins
N02	= Recovery Standard Noncompliance Dioxins
N03	= Clean-up Standard Noncompliance Dioxins
O	= Poor Instrument Performance (e.g. base-line drifting)
P	= Uncertainty near detection limit (< 2 x IDL for inorganics and < CRDL for organics)
Q	= Other problems (can encompass a number of issues; e.g. chromatography, interferences, etc.)
R	= Surrogate Recovery Noncompliance
S	= Pesticide/PCB Resolution
T	= % Breakdown Noncompliance for DDT and Endrin
U	= % Difference between columns/detectors > 25% for positive results determined via GC/HPLC
V	= Non-linear calibrations; correlation coefficient r < 0.995
W	= EMPC result
X	= Signal to noise response drop
Y	= Percent solids <30%
Z	= Uncertainty at 2 sigma deviation is greater than sample activity

PROJ_NO: 00777

SDG: SB0921 MEDIA: WATER DATA FRACTION: OV

nsample	S23GWMPM04
samp_date	2/21/2008
lab_id	SB0921-2
qc_type	NM
units	UG/L
Pct_Solids	0.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.5	U	
1,1,2,2-TETRACHLOROETHANE	0.5	U	
1,1,2-TRICHLOROETHANE	0.5	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.5	U	
1,1-DICHLOROETHANE	0.5	U	
1,1-DICHLOROETHENE	0.5	U	
1,2,3-TRICHLOROBENZENE	0.5	U	
1,2,4-TRICHLOROBENZENE	0.5	U	
1,2-DIBROMO-3-CHLOROPROPANE	0.5	U	
1,2-DIBROMOETHANE	0.5	U	
1,2-DICHLOROBENZENE	0.5	U	
1,2-DICHLOROETHANE	0.5	U	
1,2-DICHLOROPROPANE	0.5	U	
1,3-DICHLOROBENZENE	0.5	U	
1,4-DICHLOROBENZENE	0.5	U	
2-BUTANONE	5.0	U	
2-HEXANONE	5.0	U	
4-METHYL-2-PENTANONE	5.0	U	
ACETONE	5.0	U	
BENZENE	0.2	J	P
BROMOCHLOROMETHANE	0.5	U	
BROMODICHLOROMETHANE	0.5	U	
BROMOFORM	0.5	U	
BROMOMETHANE	0.5	U	
CARBON DISULFIDE	0.5	U	
CARBON TETRACHLORIDE	0.5	U	
CHLOROBENZENE	0.5	U	
CHLORODIBROMOMETHANE	0.5	U	
CHLOROETHANE	0.5	U	
CHLOROFORM	0.5	U	
CHLOROMETHANE	0.5	U	
CIS-1,2-DICHLOROETHENE	0.2	J	P

nsample	S23GWMPM04
samp_date	2/21/2008
lab_id	SB0921-2
qc_type	NM
units	UG/L
Pct_Solids	0.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
CIS-1,3-DICHLOROPROPENE	0.5	U	
CYCLOHEXANE	0.5	U	
DICHLORODIFLUOROMETHANE	0.5	U	
ETHYLBENZENE	0.5	U	
ISOPROPYLBENZENE	0.5	U	
METHYL ACETATE	0.5	U	
METHYL CYCLOHEXANE	0.5	U	
METHYL TERT-BUTYL ETHER	0.7		
METHYLENE CHLORIDE	0.5	U	
STYRENE	0.5	U	
TETRACHLOROETHENE	0.3	J	P
TOLUENE	0.5	U	
TOTAL XYLENES	0.5	U	
TRANS-1,2-DICHLOROETHENE	0.5	U	
TRANS-1,3-DICHLOROPROPENE	0.5	U	
TRICHLOROETHENE	0.4	J	P
TRICHLOROFLUOROMETHANE	0.5	U	
VINYL CHLORIDE	0.5	U	

nsample	TB022108-01
samp_date	2/21/2008
lab_id	SB0921-1
qc_type	NM
units	UG/L
Pct_Solids	0.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.5	U	
1,1,2,2-TETRACHLOROETHANE	0.5	U	
1,1,2-TRICHLOROETHANE	0.5	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.5	U	
1,1-DICHLOROETHANE	0.5	U	
1,1-DICHLOROETHENE	0.5	U	
1,2,3-TRICHLOROBENZENE	0.5	U	
1,2,4-TRICHLOROBENZENE	0.5	U	
1,2-DIBROMO-3-CHLOROPROPANE	0.5	U	
1,2-DIBROMOETHANE	0.5	U	
1,2-DICHLOROBENZENE	0.5	U	
1,2-DICHLOROETHANE	0.5	U	
1,2-DICHLOROPROPANE	0.5	U	
1,3-DICHLOROBENZENE	0.5	U	
1,4-DICHLOROBENZENE	0.5	U	
2-BUTANONE	5.0	U	
2-HEXANONE	5.0	U	
4-METHYL-2-PENTANONE	5.0	U	
ACETONE	5.0	U	
BENZENE	0.5	U	
BROMOCHLOROMETHANE	0.5	U	
BROMODICHLOROMETHANE	0.5	U	
BROMOFORM	0.5	U	
BROMOMETHANE	0.5	U	
CARBON DISULFIDE	0.5	U	
CARBON TETRACHLORIDE	0.5	U	
CHLOROBENZENE	0.5	U	
CHLORODIBROMOMETHANE	0.5	U	
CHLOROETHANE	0.5	U	
CHLOROFORM	0.5	U	
CHLOROMETHANE	0.5	U	
CIS-1,2-DICHLOROETHENE	0.5	U	

nsample	TB022108-01
samp_date	2/21/2008
lab_id	SB0921-1
qc_type	NM
units	UG/L
Pct_Solids	0.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
CIS-1,3-DICHLOROPROPENE	0.5	U	
CYCLOHEXANE	0.5	U	
DICHLORODIFLUOROMETHANE	0.5	U	
ETHYLBENZENE	0.5	U	
ISOPROPYLBENZENE	0.5	U	
METHYL ACETATE	0.5	U	
METHYL CYCLOHEXANE	0.5	U	
METHYL TERT-BUTYL ETHER	0.5	U	
METHYLENE CHLORIDE	0.5	U	
STYRENE	0.5	U	
TETRACHLOROETHENE	0.5	U	
TOLUENE	0.5	U	
TOTAL XYLENES	0.5	U	
TRANS-1,2-DICHLOROETHENE	0.5	U	
TRANS-1,3-DICHLOROPROPENE	0.5	U	
TRICHLOROETHENE	0.5	U	
TRICHLOROFLUOROMETHANE	0.5	U	
VINYL CHLORIDE	0.5	U	

PROJ_NO: 00777

SDG: SB0921 MEDIA: WATER DATA FRACTION: OS

nsample	S23GWMPM04	nsample	S23GWMPM04
samp_date	2/21/2008	samp_date	2/21/2008
lab_id	SB0921-2RE	lab_id	SB0921-2RE
qc_type	NM	qc_type	NM
units	UG/L	units	UG/L
Pct_Solids	0.0	Pct_Solids	0.0
DUP_OF:		DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2,2'-OXYBIS(1-CHLOROPROPANE)	10.0	UJ	H
2,4,5-TRICHLOROPHENOL	26.0	UJ	H
2,4,6-TRICHLOROPHENOL	10	UJ	DH
2,4-DICHLOROPHENOL	10	UJ	DH
2,4-DIMETHYLPHENOL	10.0	UJ	DH
2,4-DINITROPHENOL	26.0	UJ	H
2,4-DINITROTOLUENE	10.0	UJ	H
2,6-DINITROTOLUENE	10	UJ	H
2-CHLORONAPHTHALENE	10.0	UJ	H
2-CHLOROPHENOL	10.0	UJ	H
2-METHYLPHENOL	10	UJ	H
2-NITROANILINE	26	UJ	H
2-NITROPHENOL	10.0	UJ	H
3&4-METHYLPHENOL	10.0	UJ	DH
3,3'-DICHLOROBENZIDINE	10.0	UJ	H
3-NITROANILINE	26.0	UJ	H
4,6-DINITRO-2-METHYLPHENOL	26.0	UJ	H
4-BROMOPHENYL PHENYL ETHER	10.0	UJ	H
4-CHLORO-3-METHYLPHENOL	10.0	UJ	H
4-CHLOROANILINE	10.0	UJ	H
4-CHLOROPHENYL PHENYL ETHER	10.0	UJ	H
4-NITROPHENOL	26.0	UJ	H
BIS(2-CHLOROETHOXY)METHANE	10	UJ	H
BIS(2-CHLOROETHYL)ETHER	10	UJ	H
BUTYL BENZYL PHTHALATE	10	UJ	H
CARBAZOLE	10	UJ	H
DIBENZOFURAN	10.0	UJ	H
DIETHYL PHTHALATE	10.0	UJ	H
DIMETHYL PHTHALATE	10	UJ	H
DI-N-BUTYL PHTHALATE	10	UJ	H
DI-N-OCTYL PHTHALATE	10	UJ	H
HEXACHLOROCYCLOPENTADIENE	10	UJ	H

Parameter	Result	Val Qual	Qual Code
HEXACHLOROETHANE	10	UJ	H
ISOPHORONE	10.0	UJ	H
NITROBENZENE	10	UJ	H
N-NITROSO-DI-N-PROPYLAMINE	10.0	UJ	H
N-NITROSODIPHENYLAMINE	10	UJ	H
PHENOL	10	UJ	H

PROJ_NO: 00777

SDG: SB0921 MEDIA: WATER DATA FRACTION: PET

nsample	S23GWMPM04
samp_date	2/21/2008
lab_id	SB0921-2
qc_type	NM
Pct_Solids	0.0
DUP_OF:	

Parameter	units	Result	Val Qual	Qual Code
TOTAL PETROLEUM HYDROCAR	UG/L	75.0	U	

PROJ_NO: 00777

SDG: SB0921 MEDIA: WATER DATA FRACTION: PETF

nsample	S23GWMPM04-F
samp_date	2/21/2008
lab_id	SB0921-4
qc_type	NM
Pct_Solids	0.0
DUP_OF:	

Parameter	units	Result	Val Qual	Qual Code
TOTAL PETROLEUM HYDROCAR	UG/L	75.0	U	

PROJ_NO: 00777

SDG: SB0921 MEDIA: WATER DATA FRACTION: PAH

nsample	S23GWMPM04	nsample	S23GWMPM04-F
samp_date	2/21/2008	samp_date	2/21/2008
lab_id	SB0921-3	lab_id	SB0921-4
qc_type	NM	qc_type	NM
units	UG/L	units	UG/L
Pct_Solids	0.0	Pct_Solids	0.0
DUP_OF:		DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1-METHYLNAPHTHALENE	0.21	U	
2-METHYLNAPHTHALENE	0.21	UJ	C
4-NITROANILINE	1.0	UJ	C
ACENAPHTHENE	0.21	U	
ACENAPHTHYLENE	0.21	U	
ANTHRACENE	0.21	U	
BENZO(A)ANTHRACENE	0.045	U	
BENZO(A)PYRENE	0.21	U	
BENZO(B)FLUORANTHENE	0.082	U	
BENZO(G,H,I)PERYLENE	0.21	U	
BENZO(K)FLUORANTHENE	0.21	U	
BIS(2-ETHYLHEXYL)PHTHALATE	1.0	UJ	C
CHRYSENE	0.21	U	
DIBENZO(A,H)ANTHRACENE	0.21	U	
FLUORANTHENE	0.21	U	
FLUORENE	0.21	UJ	C
HEXACHLOROBENZENE	0.21	U	
HEXACHLOROBUTADIENE	0.21	U	
INDENO(1,2,3-CD)PYRENE	0.21	UJ	C
NAPHTHALENE	0.21	U	
PENTACHLOROPHENOL	1.0	UJ	CR
PHENANTHRENE	0.21	U	
PYRENE	0.21	U	

Parameter	Result	Val Qual	Qual Code
1-METHYLNAPHTHALENE	0.093	J	P
2-METHYLNAPHTHALENE	0.2	UJ	C
4-NITROANILINE	1.0	UJ	C
ACENAPHTHENE	0.031	J	P
ACENAPHTHYLENE	0.2	U	
ANTHRACENE	0.2	U	
BENZO(A)ANTHRACENE	0.042	U	
BENZO(A)PYRENE	0.2	U	
BENZO(B)FLUORANTHENE	0.078	U	
BENZO(G,H,I)PERYLENE	0.13	J	P
BENZO(K)FLUORANTHENE	0.2	U	
BIS(2-ETHYLHEXYL)PHTHALATE	1.0	UJ	C
CHRYSENE	0.2	U	
DIBENZO(A,H)ANTHRACENE	0.2	U	
FLUORANTHENE	0.2	U	
FLUORENE	0.2	UJ	C
HEXACHLOROBENZENE	0.2	U	
HEXACHLOROBUTADIENE	0.2	U	
INDENO(1,2,3-CD)PYRENE	0.22	J	C
NAPHTHALENE	0.069	J	P
PENTACHLOROPHENOL	1.0	UR	R
PHENANTHRENE	0.2	U	
PYRENE	0.2	U	

PROJ_NO: 00777

SDG: SB0921 MEDIA: WATER DATA FRACTION: M

nsample	S23GWMPM04
samp_date	2/21/2008
lab_id	SB0921-002
qc_type	NM
units	UG/L
Pct_Solids	0.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	29.4		
ANTIMONY	1.5	U	
ARSENIC	3.1		
BARIUM	55.9		
BERYLLIUM	0.12	U	
CADMIUM	0.1	U	
CALCIUM	34300		
CHROMIUM	0.38	U	
COBALT	0.6		
COPPER	0.8	U	
IRON	4380		
LEAD	1.4	U	
MAGNESIUM	7540		
MANGANESE	784		
MERCURY	0.02	U	
NICKEL	0.64		
POTASSIUM	5150		
SELENIUM	2.2	U	
SILVER	0.54	U	
SODIUM	50100		
THALLIUM	2.0	U	
VANADIUM	0.52	U	
ZINC	26.6		

PROJ_NO: 00777

SDG: SB0921 MEDIA: WATER DATA FRACTION: MF

nsample	S23GWMPM04-F
samp_date	2/21/2008
lab_id	SB0921-004
qc_type	NM
units	UG/L
Pct_Solids	0.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	35.4		
ANTIMONY	1.5	U	
ARSENIC	2.8		
BARIUM	56.8		
BERYLLIUM	0.12	U	
CADMIUM	0.1	U	
CALCIUM	36000		
CHROMIUM	0.38	U	
COBALT	0.64		
COPPER	0.8	U	
IRON	3750		
LEAD	1.4	U	
MAGNESIUM	8020		
MANGANESE	815		
MERCURY	0.02	U	
NICKEL	0.66		
POTASSIUM	5390		
SELENIUM	2.2	U	
SILVER	0.54	U	
SODIUM	52100		
THALLIUM	2.0	U	
VANADIUM	0.52	U	
ZINC	26.0		

PROJ_NO: 00777

SDG: SB0921 MEDIA: WATER DATA FRACTION: MISC

nsample	S23GWMPM04
samp_date	2/21/2008
lab_id	SB0921-2
qc_type	NM
Pct_Solids	0.0
DUP_OF:	

Parameter	units	Result	Lab Qual	Val Qual	Qual Code
OIL & GREASE - HEM	MG/L	1.2	U	U	

APPENDIX C

YEAR 1 ANALYTICAL DATABASE

APPENDIX C

COMPLETE ANALYTICAL DATABASE - ROUNDS 1 THROUGH 4
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

nsample	S23GWMPM01	S23GWMPM01-AVG	S23GWMPM01-D	S23GWMPM02	S23GWMPM-03	S23GWMPM-03-AVG	S23GWMPM-03-D	S23GWMPM04
location	23MP01	23MP01	23MP01	23MP01	23MP01	23MP01	23MP01	23MP01
sample_coc	S23GWMPM01	S23GWMPM01-AVG	FD-061807	S23GWMPM02	S23GWMPM-03	S23GWMPM-03-AVG	FD121807-01	S23GWMPM04
sample_dat	20070618	20070618	20070618	20070906	20071218	20071218	20071218	20080221
sacode	ORIG	AVG	DUP	NORMAL	ORIG	AVG	DUP	NORMAL
duplicate			S23GWMPM01				S23GWMPM-03	
Volatile Organics (ug/L)								
1,1,1-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-TETRACHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U
1,1,2-TRICHLOROTRIFLUOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-TRICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-TRICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DIBROMO-3-CHLOROPROPANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DIBROMOETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROPROPANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-DICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-BUTANONE	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-HEXANONE	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-METHYL-2-PENTANONE	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ACETONE	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 J
BROMOCHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMODICHLOROMETHANE	0.3 J	0.3 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOFORM	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CARBON DISULFIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLORODIBROMOMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROETHANE	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROFORM	3 J	2.5 J	2 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	0.3 J	0.25 J	0.2 J	0.3 J	0.2 J	0.2 J	0.5 U	0.2 J
CIS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U
CYCLOHEXANE	0.5 U	0.5 U	0.5 U	0.1 J	0.5 U	0.5 U	0.5 U	0.5 U
DICHLORODIFLUOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ETHYLBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U
ISOPROPYLBENZENE	0.1 J	0.095 J	0.09 J	0.1 J	0.5 U	0.5 UJ	0.5 UJ	0.5 U
METHYL ACETATE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYL CYCLOHEXANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYL TERT-BUTYL ETHER	1	0.95	0.9	0.4 J	0.6	0.6	0.6	0.7
METHYLENE CHLORIDE	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
STYRENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U
TETRACHLOROETHENE	0.3 J	0.3 J	0.3 J	0.4 J	0.3 J	0.25 J	0.2 J	0.3 J
TOLUENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U
TOTAL XYLENES	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U
TRANS-1,2-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U
TRICHLOROETHENE	0.4 J	0.35 J	0.3 J	0.5 J	0.4 J	0.35 J	0.3 J	0.4 J
TRICHLOROFLUOROMETHANE	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U
VINYL CHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

APPENDIX C

COMPLETE ANALYTICAL DATABASE - ROUNDS 1 THROUGH 4
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

nsample	S23GWMPM01	S23GWMPM01-AVG	S23GWMPM01-D	S23GWMPM02	S23GWMPM-03	S23GWMPM-03-AVG	S23GWMPM-03-D	S23GWMPM04
location	23MP01	23MP01	23MP01	23MP01	23MP01	23MP01	23MP01	23MP01
sample_coc	S23GWMPM01	S23GWMPM01-AVG	FD-061807	S23GWMPM02	S23GWMPM-03	S23GWMPM-03-AVG	FD121807-01	S23GWMPM04
sample_dat	20070618	20070618	20070618	20070906	20071218	20071218	20071218	20080221
sacode	ORIG	AVG	DUP	NORMAL	ORIG	AVG	DUP	NORMAL
duplicate			S23GWMPM01				S23GWMPM-03	
Semivolatile Organics (ug/L)								
2,2'-OXYBIS(1-CHLOROPROPANE)	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
2,4,5-TRICHLOROPHENOL	25 U	25 U	25 U	25 U	25 UJ	25 UJ	25 U	26 UJ
2,4,6-TRICHLOROPHENOL	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 UJ
2,4-DICHLOROPHENOL	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
2,4-DIMETHYLPHENOL	10 UJ	10 UJ	10 U	10 UJ	10 UJ	10 UJ	10 U	10 UJ
2,4-DINITROPHENOL	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	26 UJ
2,4-DINITROTOLUENE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
2,6-DINITROTOLUENE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
2-CHLORONAPHTHALENE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
2-CHLOROPHENOL	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 UJ
2-METHYLPHENOL	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
2-NITROANILINE	25 U	25 U	25 U	25 U	25 UJ	25 UJ	25 U	26 UJ
2-NITROPHENOL	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
3&4-METHYLPHENOL	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
3,3'-DICHLOROBENZIDINE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ
3-NITROANILINE	25 U	25 U	25 U	25 U	25 UJ	25 UJ	25 UJ	26 UJ
4,6-DINITRO-2-METHYLPHENOL	25 U	25 U	25 U	25 UJ	25 UJ	25 UJ	25 UJ	26 UJ
4-BROMOPHENYL PHENYL ETHER	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
4-CHLORO-3-METHYLPHENOL	25 U	25 U	25 U	10 U	10 UJ	10 UJ	10 U	10 UJ
4-CHLOROANILINE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
4-CHLOROPHENYL PHENYL ETHER	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
4-NITROPHENOL	25 UJ	25 UJ	25 UJ	25 U	25 UJ	25 UJ	25 UJ	26 UJ
BIS(2-CHLOROETHOXY)METHANE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
BIS(2-CHLOROETHYL)ETHER	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
BUTYL BENZYL PHTHALATE	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 UJ
CARBAZOLE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
DI-N-BUTYL PHTHALATE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
DI-N-OCTYL PHTHALATE	10 UJ	10 UJ	10 UJ	10 U	10 UJ	10 UJ	10 U	10 UJ
DIBENZOFURAN	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
DIETHYL PHTHALATE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
DIMETHYL PHTHALATE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
HEXACHLOROCYCLOPENTADIENE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ
HEXACHLOROETHANE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
ISOPHORONE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
N-NITROSO-DI-N-PROPYLAMINE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
N-NITROSODIPHENYLAMINE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
NITROBENZENE	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
PHENOL	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ
PAHs (ug/L)								
1-METHYLNAPHTHALENE	0.2 U	0.2 U	0.2 U	0.2 U	0.96 J	0.504 J	0.048 J	0.21 U
2-METHYLNAPHTHALENE	0.17 J	0.165 J	0.16 J	0.2 U	1.1 J	0.6 J	0.2 UJ	0.21 UJ
4-NITROANILINE	0.2 U	0.2 U	0.2 U	1 UJ	0.75 J	0.75 J	1 UR	1 UJ
ACENAPHTHENE	0.2 U	0.2 U	0.2 U	0.2 U	0.83 J	0.4295 J	0.029 J	0.21 U
ACENAPHTHYLENE	0.2 U	0.2 U	0.2 U	0.2 U	0.9 J	0.5 J	0.2 UJ	0.21 U
ANTHRACENE	0.2 U	0.2 U	0.2 U	0.2 U	0.92 J	0.51 J	0.2 UJ	0.21 U
BENZO(A)ANTHRACENE	0.07 U	0.07 U	0.07 U	0.041 U	1 J	0.5105 J	0.042 UJ	0.045 U
BENZO(A)PYRENE	0.2 UJ	0.2 UJ	0.2 U	0.2 U	0.35 J	0.225 J	0.2 U	0.21 U
BENZO(B)FLUORANTHENE	0.08 U	0.08 U	0.08 U	0.075 U	0.64 J	0.3395 J	0.078 UJ	0.082 U
BENZO(G,H,I)PERYLENE	0.2 UJ	0.2 UJ	0.2 U	0.2 U	0.31	0.205	0.2 U	0.21 U
BENZO(K)FLUORANTHENE	0.2 UJ	0.2 UJ	0.2 UJ	0.2 U	0.53 J	0.315 J	0.2 U	0.21 U
BIS(2-ETHYLHEXYL)PHTHALATE	1 UJ	1 UJ	1 UJ	1 U	1 U	1 U	1 U	1 UJ

APPENDIX C

COMPLETE ANALYTICAL DATABASE - ROUNDS 1 THROUGH 4
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

nsample	S23GWMPM01	S23GWMPM01-AVG	S23GWMPM01-D	S23GWMPM02	S23GWMPM-03	S23GWMPM-03-AVG	S23GWMPM-03-D	S23GWMPM04
location	23MP01	23MP01	23MP01	23MP01	23MP01	23MP01	23MP01	23MP01
sample_coc	S23GWMPM01	S23GWMPM01-AVG	FD-061807	S23GWMPM02	S23GWMPM-03	S23GWMPM-03-AVG	FD121807-01	S23GWMPM04
sample_dat	20070618	20070618	20070618	20070906	20071218	20071218	20071218	20080221
sacode	ORIG	AVG	DUP	NORMAL	ORIG	AVG	DUP	NORMAL
duplicate			S23GWMPM01				S23GWMPM-03	
PAHs (continued) (ug/L)								
CHRYSENE	0.2 U	0.2 U	0.2 U	0.2 U	0.76 J	0.43 J	0.2 UJ	0.21 U
DIBENZO(A,H)ANTHRACENE	0.2 UJ	0.2 UJ	0.2 U	0.2 U	0.14 J	0.14 J	0.2 U	0.21 U
FLUORANTHENE	0.2 U	0.2 U	0.2 U	0.2 U	1.1 J	0.6 J	0.2 UJ	0.21 U
FLUORENE	0.2 U	0.2 U	0.2 U	0.2 U	0.97 J	0.535 J	0.2 UJ	0.21 UJ
HEXACHLOROBENZENE	1 U	1 U	1 U	0.2 U	1.2 J	0.65 J	0.2 UJ	0.21 U
HEXACHLOROBUTADIENE	0.2 U	0.2 U	0.2 U	0.48 U	0.64 J	0.3448 J	0.099 U	0.21 U
INDENO(1,2,3-CD)PYRENE	0.2 UJ	0.2 UJ	0.2 U	0.2 U	0.22	0.16	0.2 U	0.21 UJ
NAPHTHALENE	0.2 U	0.2 U	0.2 U	0.2 U	1 J	0.544 J	0.088 J	0.21 U
PENTACHLOROPHENOL	1 UR	1 UR	1 UR	1 UR	1 UR	1 UR	1 UR	1 UJ
PHENANTHRENE	0.2 U	0.2 U	0.2 U	0.2 U	0.98 J	0.54 J	0.2 UJ	0.21 U
PYRENE	0.2 U	0.2 U	0.2 U	0.2 U	0.84 J	0.47 J	0.2 UJ	0.21 U
PAHs, Filtered (ug/L)								
1-METHYLNAPHTHALENE								0.093 J
2-METHYLNAPHTHALENE								0.2 UJ
4-NITROANILINE								1 UJ
ACENAPHTHENE								0.031 J
ACENAPHTHYLENE								0.2 U
ANTHRACENE								0.2 U
BENZO(A)ANTHRACENE								0.042 U
BENZO(A)PYRENE								0.2 U
BENZO(B)FLUORANTHENE								0.078 U
BENZO(G,H,I)PERYLENE								0.13 J
BENZO(K)FLUORANTHENE								0.2 U
BIS(2-ETHYLHEXYL)PHTHALATE								1 UJ
CHRYSENE								0.2 U
DIBENZO(A,H)ANTHRACENE								0.2 U
FLUORANTHENE								0.2 U
FLUORENE								0.2 UJ
HEXACHLOROBENZENE								0.2 U
HEXACHLOROBUTADIENE								0.2 U
INDENO(1,2,3-CD)PYRENE								0.22 J
NAPHTHALENE								0.069 J
PENTACHLOROPHENOL								1 UR
PHENANTHRENE								0.2 U
PYRENE								0.2 U
Inorganics (ug/L)								
ALUMINUM	473	294	115	322	38.1	29.95	21.8	29.4
ANTIMONY	2.3 U	1.9 U	1.5 U	0.87 U	1.8 U	1.45 U	1.1 U	1.5 U
ARSENIC	3.7 U	3.35 U	3.0 U	13.9	2.2 U	3.45 U	4.7 U	3.1
BARIUM	48.2	50.3	52.4	87	55.2	54.3	53.4	55.9
BERYLLIUM	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
CADMIUM	0.1 U	0.1 U	0.1 U	0.64 U	0.1 U	0.1 U	0.1 U	0.1 U
CALCIUM	33800	34800	35800	32000	35500	35100	34700	34300
CHROMIUM	0.94 U	0.875 U	0.81 U	2	0.41	0.275	0.28 U	0.38 U
COBALT	0.84 U	0.74 U	0.64 U	0.26 U	0.66	0.595	0.53	0.6
COPPER	3.0 U	3.0 U	3.0 U	4.2	0.44 U	0.33 U	0.22 U	0.8 U
IRON	9190	10545	11900	70800	9860	10030	10200	4380
LEAD	2.2	5.75	9.3	8.4	2.5 U	2.35 U	2.2 U	1.4 U
MAGNESIUM	7260	7460	7660	7020	7660	7575	7490	7540
MANGANESE	661	688	715	845	858	836.5	815	784
MERCURY	0.03 U	0.035 U	0.04 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U

APPENDIX C

COMPLETE ANALYTICAL DATABASE - ROUNDS 1 THROUGH 4
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNETICUT

nsample	S23GWMPM01	S23GWMPM01-AVG	S23GWMPM01-D	S23GWMPM02	S23GWMPM-03	S23GWMPM-03-AVG	S23GWMPM-03-D	S23GWMPM04
location	23MP01	23MP01	23MP01	23MP01	23MP01	23MP01	23MP01	23MP01
sample_coc	S23GWMPM01	S23GWMPM01-AVG	FD-061807	S23GWMPM02	S23GWMPM-03	S23GWMPM-03-AVG	FD121807-01	S23GWMPM04
sample_dat	20070618	20070618	20070618	20070906	20071218	20071218	20071218	20080221
sacode	ORIG	AVG	DUP	NORMAL	ORIG	AVG	DUP	NORMAL
duplicate			S23GWMPM01				S23GWMPM-03	
Inorganics (continued) (ug/L)								
NICKEL	1.0 U	0.885 U	0.77 U	0.41 U	0.53	0.495	0.46	0.64
POTASSIUM	5210	5350	5490	5270	5590	5540	5490	5150
SELENIUM	1.5 U	1.375 J	2.0 J	1.5 U	1.5 U	1.5 U	1.5 U	2.2 U
SILVER	0.46 U	0.46 U	0.46 U	1.5	0.46 U	0.46 U	0.46 U	0.54 U
SODIUM	46900	48250	49600	52100	53400	52850	52300	50100
THALLIUM	0.99 U	1.645 U	2.3 U	0.98 U	0.71 U	0.71 U	0.71 U	2.0 U
VANADIUM	1.3 U	1.35 U	1.4 U	3.7	0.34 U	0.315 U	0.29 U	0.52 U
ZINC	21.3 J	21.8 J	22.3	47.1	22.8	21.4	20	26.6
Inorganics, Filtered (ug/L)								
ALUMINUM	20.4 J	28.55 J	36.7 J	21.3 J	19 U	19 U	19 U	35.4
ANTIMONY	0.87 U	1.235 U	1.6 U	0.87 U	0.87 U	1.085 U	1.3 U	1.5 U
ARSENIC	3.5 U	2.85 U	2.2 U	1.2 J	1.9 U	1.5 U	1.1 U	2.8
BARIUM	44.6	45.5	46.4	50.1	48.9	49.25	49.6	56.8
BERYLLIUM	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
CADMIUM	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
CALCIUM	33600	34150	34700	31400	33100	33250	33400	36000
CHROMIUM	1.2 U	0.82 U	0.44 U	0.3 J	0.29	0.385	0.48	0.38 U
COBALT	0.67 U	0.765 U	0.86 U	0.47 J	0.48	0.495	0.51	0.64
COPPER	14.9 U	8.55 U	2.2 U	0.7 U	0.22 U	0.45 U	0.68 U	0.8 U
IRON	3470	3550	3630	3600	4190	4165	4140	3750
LEAD	1.3 J	1.55 J	1.8 J	1.1 U	2.1 U	2.45 U	2.8 U	1.4 U
MAGNESIUM	7200	7340	7480	6980	7250	7275	7300	8020
MANGANESE	645	654.5	664	708	764	767	770	815
MERCURY	0.03 U	0.035 U	0.04 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
NICKEL	1.1 U	0.99 U	0.88 U	0.78 J	1	0.82	0.64	0.66
POTASSIUM	5090	5240	5390	5320	5360	5375	5390	5390
SELENIUM	1.5 U	1.225 J	1.7 J	2.4 U	1.5 U	1.9 U	2.3 U	2.2 U
SILVER	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U	0.54 U
SODIUM	46600	47500	48400	52600	50400	50900	51400	52100
THALLIUM	1.2 U	1.065 U	0.93 U	1.7 U	0.71 U	0.71 U	0.71 U	2 U
VANADIUM	0.7 U	0.63 U	0.56 U	0.29 U	0.29 U	0.29 U	0.29 U	0.52 U
ZINC	21.4 J	20.45 J	19.5 J	15	18.6	19.7	20.8	26
Oil & Grease (ug/L)								
OIL & GREASE - HEM	1200 U	1200 U	1200 U	1200 U	1200 UJ	1200 UJ	1200 U	1200 U
Petroleum Hydrocarbons (ug/L)								
TOTAL PETROLEUM HYDROCARBONS	55 J	55 J	79 U	140 J	160 U	840 J	1600 J	75 U
Petroleum Hydrocarbons, Filtered (ug/L)								
TOTAL PETROLEUM HYDROCARBONS								75 U

APPENDIX D

HUMAN HEALTH RISK ASSESSMENT MEMORANDUM

From: Bob Jupin, Tetra Tech Risk Assessment Specialist

To: Corey Rich, Tetra Tech Project Manager

Date: May 19, 2008

Regarding: Human Health Risks Associated with Site 23 Groundwater

Historical and current information pertaining to Site 23 groundwater were reviewed to determine if Site 23 groundwater poses a threat to human health and the environment. Historical information reviewed as part of this evaluation included the Basewide Groundwater Operable Unit Remedial Investigation Report (BGOURI) (Tetra Tech, 2002) and data collected as part of the storm sewer rehabilitation (FWEC, 2001). Current data reviewed as part of this evaluation included the first four quarters of the underdrain metering pit sampling collected through February, 2008.

There have been changes in United States Environmental Protection Agency (USEPA) and Connecticut Department of Environmental Protection (CTDEP) guidance since the BGOURI HHRA was prepared. The major changes in guidance include:

- USEPA Region 9 Preliminary Remedial Goals (2004)
- CTDEP Remediation Standard Regulations (RSRs) Volatilization Criteria (2003)
- Draft Guidance for Evaluating the Vapor Intrusion into Indoor Air (USEPA, 2002).
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final Guidance (USEPA, 2004).
- Guidelines for Carcinogen Risk Assessment (USEPA, 2005a).
- Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005b).

The revised guidance was used in this evaluation.

Site Description

Figure 1-1 shows the general location of the Naval Submarine Base and Figure 1-2 shows the location of Site 23. No. 2 and No. 6 fuel oil and waste oil were previously stored in underground storage tanks (USTs) at Site 23 and each tank had an underdrain system that collected groundwater to control water levels and associated hydraulic pressure. The USTs were properly closed in place and the underdrain systems were kept to reduce groundwater levels in the area. Evidence of releases of petroleum products from the tanks, their associated piping, and possibly from other nearby sources was detected during previous investigations. Remedial actions were taken to address petroleum products detected in the soil. No significant groundwater contamination was detected; however, low-levels of petroleum hydrocarbons were infrequently detected at the outfall of the storm sewer system near Goss Cove. Subsequently, the storm sewer at Site 23 was rehabilitated in 2000 such that the original combined groundwater and stormwater system was separated into a deep groundwater and a new shallow stormwater system (FWEC, 2001). Over 2,000 feet of the existing underdrain piping was relined with cured-in-place plastic pipe and a manhole was converted into a metering pit to measure groundwater flow volume.

Current and expected future site usage is industrial/commercial. Groundwater at Site 23 is classified GB. Groundwater at Site 23 is not used as a potable water source. Currently there are no direct contact exposures to groundwater. Potential receptors evaluated in the human health risk assessments for Site 23 included construction workers and hypothetical future residents.

Basewide Groundwater Operable Unit Remedial Investigation Report

Groundwater at Site 23 was evaluated in the BGOURI (Tetra Tech, 2002). As part of the evaluation concentrations of chemicals in groundwater were compare to USEPA and CTDEP screening criteria for direct contact (USEPA Region IX Preliminary Remedial Goals, USEPA Maximum Contaminant Levels, CTDEP Maximum Contaminant Levels, and CTDEP RSRs) and migration (CTDEP volatilization and surface water protection criteria). A copy of the comparisons is included in Attachment A.1. Maximum concentrations of tetrachloroethene, naphthalene, and lead exceeded the direct contact criteria (Table 13-4). Arsenic and lead were detected at concentrations exceeding the surface water protection criteria (Table 13-5). The human health risk assessment (HHRA) evaluated potential risks from exposures to groundwater by construction workers and hypothetical residents. The HHRA determined that risks for construction workers were less than USEPA and CTDEP acceptable levels (Table 13-6). Risk for future residents were within USEPA and CTDEP acceptable levels. However, the chemical specific cancer risk for tetrachloroethene exceeded the CTDEP target level of 1×10^{-6} for individual chemicals, although the maximum detected concentration of tetrachloroethene was less than its CTDEP RSR. The HHRA guidance has been updated since the BGOURI was prepared, but the changes in the HHRA guidance would not change the conclusions of the HHRA.

Storm Sewer Rehabilitation

The storm sewer system at Site 23 was rehabilitated in 2000 (FWEC, 2001). After completion of the storm sewer system, groundwater collected from the deep dewatering system around the closed underground storage tanks is conveyed to a metering pit within the Tank Farm. The metering pit is connected to the shallow stormwater system and the water is conveyed to the Thames River. Seven groundwater samples were collected from the metering pit between July 25, 2000 and May 23, 2001. A summary of the sample analytical results are included in Table 1 in Attachment A.2. it should be noted that this data was not validated. Table 1 includes a comparison of the data to CTDEP RSRs for surface water protection and volatilization. Concentrations of all chemicals in all seven groundwater samples were less than the volatilization criteria. Concentrations of total zinc exceeded the surface water protection criteria in samples collected in August and October, 2000. Concentrations of total lead exceeded the surface water protection criteria in samples collected in August 2000, October 2000, January 2001, April 2001, and May 2001. Concentrations of total arsenic exceeded the surface water protection criteria in samples collected in August 2000, October 2000, March 2001, April 2001, and May 2001, although total arsenic was also detected in the blank samples collected in 2001, indicating a potential laboratory blank contamination issue. Concentrations of all inorganics in filtered samples were less than the surface water protection criteria in all samples, suggesting that the elevated total arsenic and lead results were related to suspended soils in the samples. In general, concentrations of inorganics were highest in samples collected in August and October of 2000 shortly after completion of construction of the new storm water system and decreased significantly in subsequent sampling rounds. Concentrations of phenanthrene exceeded the surface water protection criteria in the samples collected in January 2001 and May 2001. Concentrations of benzo(b)fluoranthene, and benzo(k)fluoranthene exceeded the surface water protection criteria in the sample collected in May 2001. Considering the new risk methodology risks for construction workers exposed to groundwater would be within USEPA and CTDEP acceptable levels using the last round of sampling results (May 2001) (Attachment A.3).

Quarterly Underdrain Metering Pit Sampling

Four quarters of water samples were collected from the metering pit (Tetra Tech, 2008), which began in June 2007. The results of the sampling are presented in Table 3-1 in Attachment A.4. Included in Table 3-1 is a comparison to CTDEP RSRs for surface water protection and volatilization. None of the detected concentrations in the samples exceeded CTDEP volatilization criteria. In the sample collected in September 2007, the concentration of total arsenic exceeded the surface water protection criteria. However, the concentration of arsenic in the filtered sample was below the surface water protection criteria. In general concentrations of inorganics in the filtered samples were significantly less than the concentrations detected in the unfiltered samples. Also the sample log sheet indicates that orange precipitate was observed in the sample. Therefore, it is likely that the arsenic detected in the unfiltered sample was a result of suspended solid particles in the water and is not indicative of groundwater quality. Arsenic was not detected in the sample collected in December 2007 and was detected at a concentration below the surface water protection criteria in the sample collected in February 2008. In December 2007, concentrations of acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, hexachlorobenzene, and phenanthrene exceeded the surface water protection criteria. These chemicals were not detected in the duplicate sample collected in December 2007 and these chemicals were not detected in the sample collected in February 2008.

Table 2.1 in Attachment A.5 presents a comparison of the sampling results to human health screening criteria consisting of USEPA Region IX Preliminary Remediation Goals (PRGs) for tap water, USEPA Maximum Contaminant Levels (MCLs), CTDEP RSRs, and Connecticut MCLs. Several VOCs, SVOCs, and inorganics were detected at concentrations exceeding the human health screening criteria. Attachment A.5 also presents the results of a human health risk assessment (HHRA) for construction workers and hypothetical residents exposed to groundwater from the underdrain metering pit. Risks for construction workers exposed to groundwater are within USEPA and CTDEP acceptable levels. Cancer risks and hazard indices for hypothetical residents exceed USEPA and CTDEP acceptable levels, although Site 23 is not suitable for residential development. Hexachlorobenzene, carcinogenic PAHs, and arsenic were the major contributors to the cancer risks. Arsenic, iron, and manganese are the major contributors to the hazard indices. As discussed above hexachlorobenzene and carcinogenic PAHs were only detected in the sample collected in December 2007. Concentrations of arsenic and iron were only elevated in the sample collected in September 2007. In addition, concentrations of arsenic and iron in the filtered sample were significantly lower than those in the unfiltered sample. Concentrations of manganese were within site background levels.

Vapor Intrusion Evaluation for Groundwater

Groundwater data from Site 23 were evaluated to determine if there were unacceptable risks associated with vapor intrusion into buildings (Tetra Tech, 2008). Concentrations of volatile organic compounds (VOCs) in groundwater were compared to screening criteria for vapor intrusion. The screening criteria were obtained from USEPA's *OSWER Draft Guidance for Evaluating the Vapor Intrusion into Indoor Air from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), November 2002,* CTDEP's *Proposed Revisions - Connecticut's Remediation Standard Regulations Volatilization Criteria, March 2003,* and USEPA Region I (April 24, 2008). Concentrations of chloroform and trichloroethene at Site 23 exceeded the USEPA screening criterion. These chemicals were further evaluated using USEPA's Johnson and Ettinger Vapor Intrusion Model. Modeling results showed that cancer risks and hazard indices for residential and industrial scenarios were within USEPA and CTDEP acceptable levels at Site 23. Further evaluation against PRGs and ARARs showed that vapor intrusion is not an issue at Site 23. It was concluded that no further action was required for vapor intrusion issues at Site 23.

Conclusions

Historical and current information pertaining to Site 23 groundwater were reviewed to determine if Site 23 groundwater poses a threat to human health and the environment. The conclusions of this evaluation are the following:

- The HHRA performed during the BGOURI evaluated potential risks from exposures to groundwater by construction workers and hypothetical residents, although it is unlikely that direct contact exposures to Site 23 groundwater would occur based on current and expected future site use. Cumulative risks were less than or within USEPA and CTDEP acceptable levels. However, chemical-specific risks for tetrachloroethene exceeded the CTDEP target level for individual chemicals, although the maximum detected concentration of tetrachloroethene was less than its CTDEP RSR (5 μg/L). Concentrations of tetrachloroethene in Site 23 groundwater have decreased from 3 μg/L in the BGOURI to 0.3 J μg/L during the forth quarter of the underdrain meter pit sampling. Chemical-specific risks associated with tetrachloroethene would now be less than the CTDEP target level for individual chemicals.
- The HHRA guidance has been revised since the BGOURI HHRA was prepared but the changes in the guidance would not change the conclusions of the HHRA.
- Concentrations of chemicals in groundwater samples collected after the storm sewer rehabilitation were highest in samples collected in August and October, 2000 right after completion of construction and decreased significantly in subsequent sampling rounds.
- Concentrations of all chemicals detected in groundwater collected during the four quarters of the underdrain metering pit sampling were less than that CTDEP surface water protection and volatilization criteria with the exception of arsenic and several SVOCs. The concentration of total arsenic in the sample collected in September 2007 exceeded the surface water protection criteria although the concentration of arsenic in the filtered sample was less than the surface water protection criteria. The arsenic detected in the unfiltered sample is believed to be a result of suspended solid particles in the water and the filtered sample is more indicative of groundwater quality. Concentrations of acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, hexachlorobenzene, and phenanthrene exceeded the surface water protection criteria. These chemicals were not detected in the duplicate sample collected in December 2007 and these chemicals were not detected in the sample collected in February 2008.
- In general, concentrations of chemicals in Site 23 groundwater have decreased over time except as noted above.
- Potential risks for construction workers exposed to Site 23 groundwater are still acceptable using the analytical results from the four rounds of groundwater sampling. Potential risks for hypothetical residents exposed to Site 23 groundwater exceed acceptable levels, although Site 23 is not suitable for residential development.
- The vapor intrusion evaluation for groundwater determined that risks from vapor intrusion were with USEPA and CTDEP acceptable levels for residential and industrial scenarios. The evaluation concluded that no further action was required for vapor intrusion issues at Site 23.

References

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USEPA, 2005b. Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens. EPA/630/R-03/003F. Risk Assessment Forum, Washington, DC. March.

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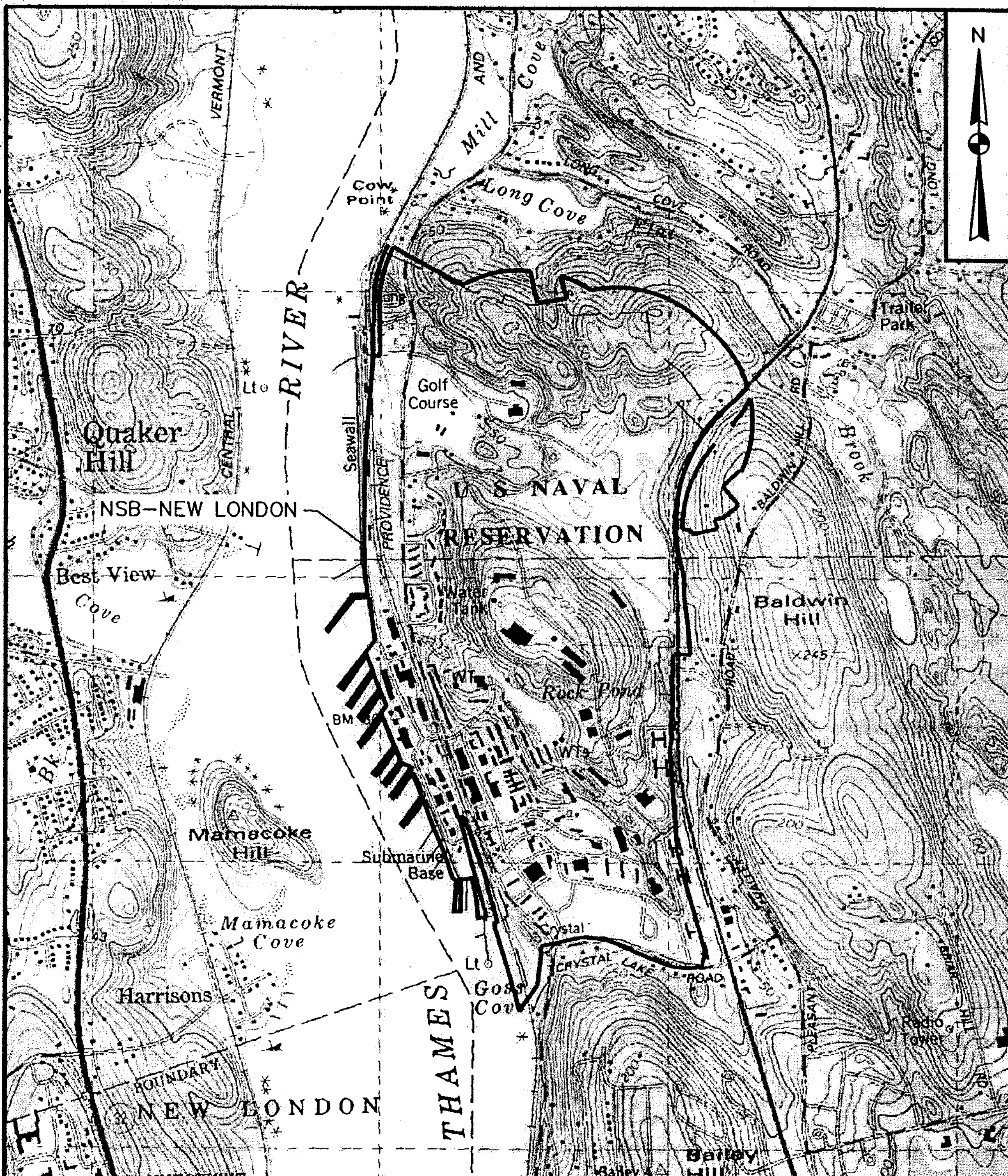
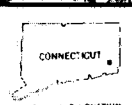
FIGURES

ACAD:0777cm01.dwg 04/25/07 DT PIT





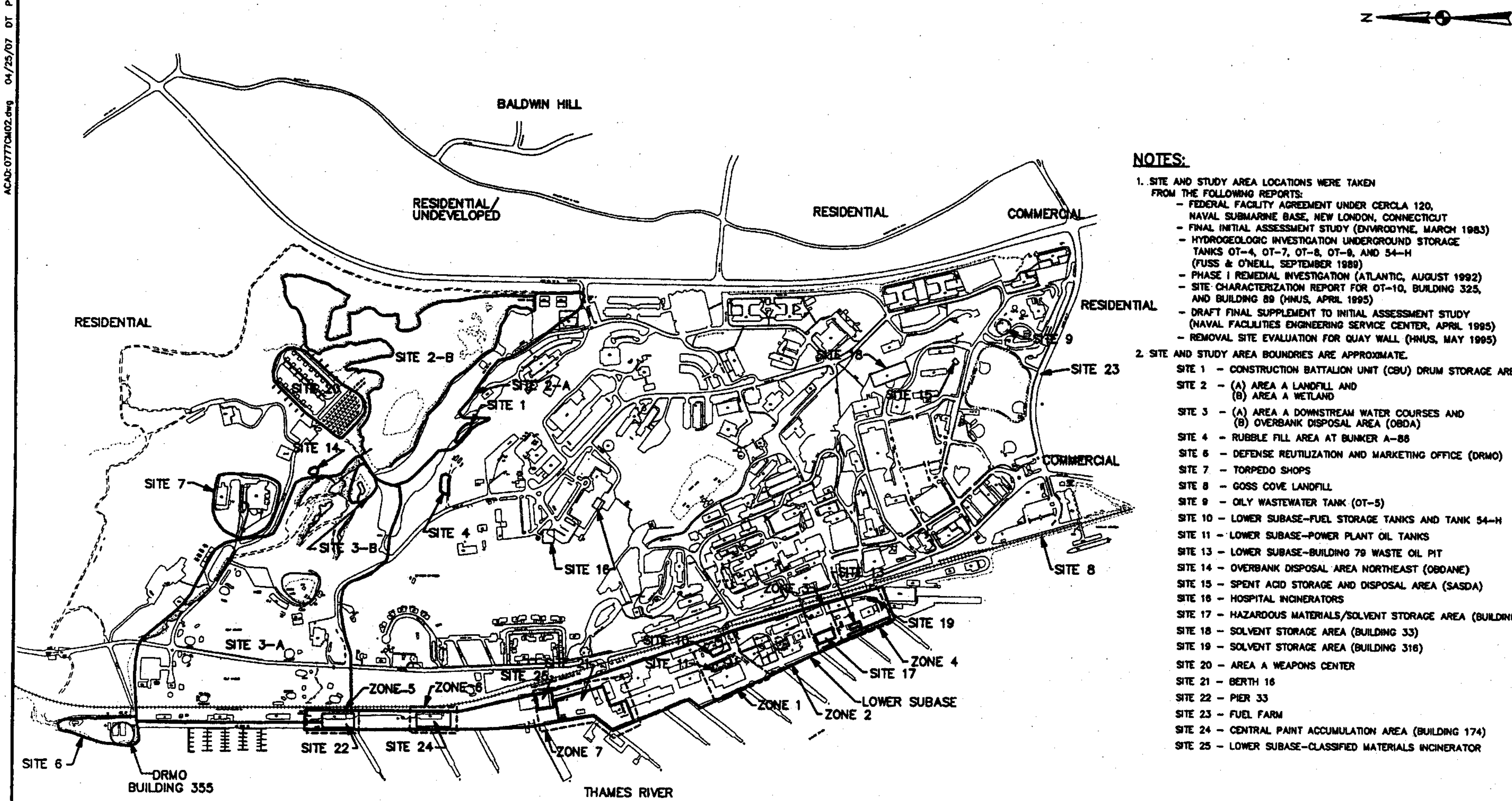
0 2000 4000

GRAPHIC SCALE IN FEET

SOURCE: USGS QUADRANGLE MAP UNCASVILLE, CONNECTICUT, 1984

DRAWN BY DT	DATE 4/25/07	Tetra Tech NUS, Inc.	FACILITY LOCATION MAP NSB-NLON GROTON, CONNECTICUT	CONTRACT NO. 0777	
CHECKED BY NJB	DATE 4/27/07			OWNER NO. 073	
REVISED BY	DATE			APPROVED BY CAR	DATE 4/27/07
SCALE AS NOTED				DRAWING NO. FIGURE 1-1	REV. 0

FORM CADD NO. TTNUS-AV.DWG – REV 1 -9/10/98



ACAD:0777CM02.dwg 04/25/07 DT PIT

NOTES:

1. SITE AND STUDY AREA LOCATIONS WERE TAKEN FROM THE FOLLOWING REPORTS:
   - FEDERAL FACILITY AGREEMENT UNDER CERCLA 120, NAVAL SUBMARINE BASE, NEW LONDON, CONNECTICUT
   - FINAL INITIAL ASSESSMENT STUDY (ENVIRODYNE, MARCH 1983)
   - HYDROGEOLOGIC INVESTIGATION UNDERGROUND STORAGE TANKS OT-4, OT-7, OT-8, OT-9, AND 54-H (FUSS & O'NEILL, SEPTEMBER 1989)
   - PHASE I REMEDIAL INVESTIGATION (ATLANTIC, AUGUST 1992)
   - SITE CHARACTERIZATION REPORT FOR OT-10, BUILDING 325, AND BUILDING 89 (HNUS, APRIL 1995)
   - DRAFT FINAL SUPPLEMENT TO INITIAL ASSESSMENT STUDY (NAVAL FACILITIES ENGINEERING SERVICE CENTER, APRIL 1995)
   - REMOVAL SITE EVALUATION FOR QUAY WALL (HNUS, MAY 1995)
2. SITE AND STUDY AREA BOUNDRIES ARE APPROXIMATE.

SITE 1 – CONSTRUCTION BATTALION UNIT (CBU) DRUM STORAGE AREA
SITE 2 – (A) AREA A LANDFILL AND (B) AREA A WETLAND
SITE 3 – (A) AREA A DOWNSTREAM WATER COURSES AND (B) OVERBANK DISPOSAL AREA (OBDA)
SITE 4 – RUBBLE FILL AREA AT BUNKER A-86
SITE 6 – DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO)
SITE 7 – TORPEDO SHOPS
SITE 8 – GOSS COVE LANDFILL
SITE 9 – OILY WASTEWATER TANK (OT-5)
SITE 10 – LOWER SUBASE-FUEL STORAGE TANKS AND TANK 54-H
SITE 11 – LOWER SUBASE-POWER PLANT OIL TANKS
SITE 13 – LOWER SUBASE-BUILDING 79 WASTE OIL PIT
SITE 14 – OVERBANK DISPOSAL AREA NORTHEAST (OBDANE)
SITE 15 – SPENT ACID STORAGE AND DISPOSAL AREA (SASDA)
SITE 16 – HOSPITAL INCINERATORS
SITE 17 – HAZARDOUS MATERIALS/SOLVENT STORAGE AREA (BUILDING 31)
SITE 18 – SOLVENT STORAGE AREA (BUILDING 33)
SITE 19 – SOLVENT STORAGE AREA (BUILDING 316)
SITE 20 – AREA A WEAPONS CENTER
SITE 21 – BERTH 16
SITE 22 – PIER 33
SITE 23 – FUEL FARM
SITE 24 – CENTRAL PAINT ACCUMULATION AREA (BUILDING 174)
SITE 25 – LOWER SUBASE-CLASSIFIED MATERIALS INCINERATOR

0 800 1600
GRAPHIC SCALE IN FEET

BASE MAP SOURCE: PREPARED BY THE NAVAL SUBMARINE BASE PUBLIC WORKS DEPT., ENGINEERING DIVISION. MARCH 2006, DRAWING NO. A-667.

DRAWN BY DT	DATE 4/25/07	Tetra Tech NUS, Inc.	SITE LOCATION MAP NSB-NLON GROTON, CONNECTICUT	CONTRACT NO. 0777
CHECKED BY NJG	DATE 4/27/07			OWNER NO. 073
REVISED BY	DATE			APPROVED BY CAL DATE 4/27/07
SCALE AS NOTED				DRAWING NO. FIGURE 1-2 REV. 0

FORM CADD NO. TTNUS-BH.DWG – REV 1 – 9/10/98

ATTACHMENT A.1
TABLES FROM BASEWIDE GROUNDWATER OPERABLE UNIT REPORT

TABLE 13-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN FOR GROUNDWATER AT SITE 23
DIRECT CONTACT EXPOSURE SCENARIOS
BASEWIDE GROUNDWATER OPERABLE UNIT REMEDIAL INVESTIGATION
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tank Farm (Site 23)

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Background Value (4)	Risk-Based COPC Screening Level (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
Volatile Organics																
	M+P-XYLENES	2		2		ug/L	S23MW02S01	1/7	2	2	N/A	21 N(7)	530 10000 10000	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL
95-47-6	O-XYLENE	3		3		ug/L	S23MW02S01	1/7	1	3	N/A	21 N(7)	530 10000 10000	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL
127-18-4	TETRACHLOROETHENE	3		3		ug/L	S23MW03D01	1/3	1	3	N/A	0.1 C	5 5 5	CTDEP RSR FED-MCL CTDEP-MCL	YES	ASL
1330-20-7	XYLENES, TOTAL	5		5		ug/L	S23MW02S01	1/7	1	5	N/A	21 N	530 10000 10000	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL
Dissolved Gases																
74-82-8	METHANE	1		920		ug/L	S23MW02S01	7/10	1	920	N/A	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	NTX
Semivolatile Organics																
91-20-3	NAPHTHALENE	1.4		1.4		ug/L	S23MW02S01	1/7	0.5 - 5	1.4	N/A	0.62 N	280 N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	YES	ASL
Total Metals																
7429-90-5	ALUMINUM	890		2030		ug/L	S23MW02S01	1/7	50.5 - 591	2030	3560	3600 N	N/A 50 to 200 N/A	CTDEP RSR FED-SMCL CTDEP-MCL	NO	EPAI, BKG
7440-38-2	ARSENIC	4.7		4.7		ug/L	S23HNUS1101	1/7	2.3	4.7	1.92	N/A	50 10 50	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL
7440-39-3	BARIUM	27.2		176		ug/L	S23MW02S01	1/7	18 - 37	176	227	730 N	1000 2000 2000	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL, BKG
7440-43-9	CADMIUM	0.63		0.63		ug/L	S23HNUS2001	4/7	0.25	0.63	ND	1.8 N	5 5 5	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL
7440-70-2	CALCIUM	6270		94100		ug/L	S23MW03D01	10/10	N/A	94100	188000	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	NUT, BKG
7440-47-3	CHROMIUM	10.2	J	43.2		ug/L	S23MW02S01	4/10	6.2	43.2	49.9	11 N(8)	50 100 N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL, BKG
7440-48-4	COBALT	4.5	J	6.4	J	ug/L	S23MW02S01,	4/10	4.2 - 5.2	6.4	48.6	73 N	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL, BKG
7440-50-8	COPPER	6.8	J	10.7	J	ug/L	S23MW02S01	2/10	6.8	10.7	107	150 N	1300 1300 N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL, BKG
7439-89-6	IRON	202		24800		ug/L	S23MW02S01	9/10	175	24800	28200	2600 N(10)	N/A 300 N/A	CTDEP RSR FED-SMCL CTDEP-MCL	NO	EPAI, BKG

TABLE 13-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN FOR GROUNDWATER AT SITE 23
DIRECT CONTACT EXPOSURE SCENARIOS
BASEWIDE GROUNDWATER OPERABLE UNIT REMEDIAL INVESTIGATION
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tank Farm (Site 23)

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	Risk-Based COPC Screening Level(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
7439-92-1	LEAD	1.9	J	31.2		ug/L	S23MW02S01	5/10	1.8	31.2	6.63	N/A	15 15 N/A	CTDEP RSR FED-AL CTDEP-MCL	YES	ASL
7439-95-4	MAGNESIUM	1610		7840		ug/L	S23MW02S01	9/10	544	7840	191000	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	NUT, BKG
7439-96-5	MANGANESE	41.4	J	3380		ug/L	S23MW02S01	8/10	8.8 - 12.1	3380	11700	88 N	N/A 50 N/A	CTDEP RSR FED-SMCL CTDEP-MCL	NO	BKG
7440-02-0	NICKEL	10	J	33.5		ug/L	S23MW02S01	2/10	9.2 - 9.9	33.5	32.2	73 N	100 100 100	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL
7440-09-7	POTASSIUM	1170		7790		ug/L	S23MW02S01	10/10	N/A	7790	70800	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	NUT, BKG
7440-23-5	SODIUM	7790	J	99200	J	ug/L	S23HNUS201	10/10	N/A	99200	1900000	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	NUT, BKG
7440-62-2	VANADIUM	6.4	J	6.4	J	ug/L	S23MW03D01	1/10	6.3 - 8.2	6.4	10.2	3.6 N	50 N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL, BKG
7440-66-6	ZINC	68.4		68.4		ug/L	S23MW02S01	1/10	10.9 - 43.1	68.4	131	1100 N	5000 5000 N/A	CTDEP RSR FED-SMCL CTDEP-MCL	NO	BSL, BKG
Dissolved Metals																
7440-38-2	ARSENIC, FILTERED	3.1	J	3.1	J	ug/L	S23MW02S01-F	1/2	2.3	3.1	2.55	N/A	50 10 50	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL
7440-39-3	BARIUM, FILTERED	33.8		150		ug/L	S23MW02S01-F	2/2	N/A	150	124	260 N	1000 2000 2000	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL
7440-70-2	CALCIUM, FILTERED	33000		45100		ug/L	S23MW02S01-F	2/2	N/A	45100	152000	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL, BKG
7439-89-6	IRON, FILTERED	4410		15400		ug/L	S23MW02S01-F	2/2	N/A	15400	25300	2600 N(10)	N/A 300 N/A	CTDEP RSR FED-SMCL CTDEP-MCL	NO	EPAI, BKG
7439-92-1	LEAD, FILTERED	10		10		ug/L	S23MW02S01-F	1/2	1.8	10	2.52	N/A	15 15 N/A	CTDEP RSR FED-AL CTDEP-MCL	NO	BSL
7439-95-4	MAGNESIUM, FILTERED	3770		5830		ug/L	S23MW02S01-F	2/2	N/A	5830	150000	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	BSL, BKG
7439-96-5	MANGANESE, FILTERED	977		2650		ug/L	S23MW02S01-F	2/2	N/A	2650	9400	88 N	N/A 50 N/A	CTDEP RSR FED-SMCL CTDEP-MCL	NO	BKG
7440-09-7	POTASSIUM, FILTERED	5500		7340		ug/L	S23MW02S01-F	2/2	N/A	7340	60000	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	NUT, BKG
7440-23-5	SODIUM, FILTERED	49300		82600	J	ug/L	S23HNUS201-F	2/2	N/A	82600	1580000	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	NUT, BKG

TABLE 13-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN FOR GROUNDWATER AT SITE 23
DIRECT CONTACT EXPOSURE SCENARIOS
BASEWIDE GROUNDWATER OPERABLE UNIT REMEDIAL INVESTIGATION
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tank Farm (Site 23)

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	Risk-Based COPC Screening Level(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
Miscellaneous Parameters																
E-14506	ALKALINITY	18		348		mg/L	S23MW03D01	10/10	N/A	348	1950	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	BKG
7664-41-7	AMMONIA	0.16	J	0.54	J	mg/L	S23HNUS201	3/3	N/A	0.54	ND	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	NTX
7664-41-7	AMMONIA, AS NITROGEN	0.13	J	6.9	J	mg/L	S23MW02S01	6/7	100	6.9	ND	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	NTX
000-02-0	CHLORIDE	6.55		124		mg/L	S23MW02S01	10/10	N/A	124	4540	N/A	N/A 250 N/A	CTDEP RSR FED-SMCL CTDEP-MCL	NO	BSL
E-11778	HARDNESS as CaCO3	22.3		257		mg/L	S23MW03D01	10/10	N/A	257	ND	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	NTX
14808-79-8	SULFATE	7.6		47.2		mg/L	S23HNUS2001	10/10	N/A	47.2	45.2	N/A	N/A 250 N/A	CTDEP RSR FED-SMCL CTDEP-MCL	NO	BSL
000-09-0	TOTAL DISSOLVED SOLIDS	66.2		519	J	mg/L	S23MW02S01	10/10	N/A	519	6260	N/A	N/A 500 N/A	CTDEP RSR FED-SMCL CTDEP-MCL	NO	BKG
7440-44-0	TOTAL ORGANIC CARBON	1	J	9		mg/L	S23MW04S01	10/10	N/A	9	37.7	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	BKG
000-08-9	TOTAL SUSPENDED SOLIDS	6	J	169	J	mg/L	S23MW02S01	6/10	5000	169	236	N/A	N/A N/A N/A	CTDEP RSR FED-MCL CTDEP-MCL	NO	BKG

A shaded value indicates that the concentration used for screening exceeds the criterion or background value.
A shaded chemical name indicates that the chemical has been selected as a COPC.

Footnotes:

1 Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 95% Upper Tolerance Limit (UTL) of site background data .
5 The risk-based COPC screening level for tap water use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (USEPA, Region IX, October 2004, Update December 28, 2004).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Value is for total xylenes.
8 Value is for hexavalent chromium.

Associated Samples:

S23HNUS1101	S23MW02D01	S23MW04S01
S23HNUS1301	S23MW02D01-D	
S23HNUS2001	S23MW02S01	
S23HNUS201	S23MW02S01-F	
S23HNUS201-F	S23MW03D01	
S23HNUS501	S23MW04D01	

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered.
C = Carcinogen.
COC = Chemical of Concern
J = Estimated Value
N = Noncarcinogen.
N/A = Not Applicable.
FED-MCL = Federal Maximum Contaminant Level (USEPA, August 2000).
FED-SMCL = Federal Secondary Maximum Contaminant Level (USEPA, August 2000).
FED-AL = Federal Action Level (USEPA, August 2000)
CTDEP-RSR = Connecticut DEP Remediation Standard Regulations, 1996.
CTDEP-MCL = Connecticut Maximum Contaminant Level.

Rationale Codes:
For Selection as a COC:
ASL = Above COC Screening Level/ARAR/TBC.

For Elimination as a COC:
BKG = Within Background Levels.
BSL = Below COC Screening Level/ARAR/TBC
NUT = Essential Nutrient.
NTX = No Toxicity Information.
EPAI = USEPA Region 1 does not advocate evaluation of this chemical.
NV = Miscellaneous parameters are not evaluated in human health risk assessments.

TABLE 13-5

OCCURRENCE, DISTRIBUITON, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN FOR GROUNDWATER AT SITE 23
MIGRATION PATHWAYS
BASEWIDE GROUNDWATER OPERABLE UNIT REMEDIAL INVESTIGATION
NSB-NLON, GROTON, CONECTICUT
PAGE 1 OF 2

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tank Farm (Site 23)

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	CTDEP Surface Water Criteria(5)	CTDEP Vol. Criteria(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
Volatile Organics															
	M+P-XYLENES	2		2		ug/L	S23MW02S01	1/10	2	2	NA	NA	21300	NO	BSL
95-47-6	O-XYLENE	3		3		ug/L	S23MW02S01	1/10	1	3	NA	NA	21300	NO	BSL
127-18-4	TETRACHLOROETHENE	3		3		ug/L	S23MW03D01	1/10	1	3	NA	88	1500	NO	BSL
1330-20-7	XYLENES, TOTAL	5		5		ug/L	S23MW02S01	1/10	1	5	NA	NA	21300	NO	BSL
Dissolved Gases															
74-82-8	METHANE	1		920		ug/L	S23MW02S01	7/10	1	920	NA	N/A	N/A	NO	NTX
Semivolatile Organics															
91-20-3	NAPHTHALENE	1.4		1.4		ug/L	S23MW02S01	1/10	0.5 - 5	1.4	NA	N/A	N/A	NO	NTX
Total Metals															
7429-90-5	ALUMINUM	890		2030		ug/L	S23MW02S01	2/10	50.5 - 591	2030	3560	N/A	N/A	NO	BKG
7440-38-2	ARSENIC	4.7		4.7		ug/L	S23HNUS1101	1/10	2.3	4.7	1.92	4	N/A	YES	ASL
7440-39-3	BARIUM	27.2		176		ug/L	S23MW02S01	4/10	18 - 37	176	227	N/A	N/A	NO	BKG
7440-43-9	CADMIUM	0.63		0.63		ug/L	S23HNUS2001	1/10	0.25	0.63	ND	6	N/A	NO	BSL
7440-70-2	CALCIUM	6270		94100		ug/L	S23MW03D01	10/10	N/A	94100	188000	N/A	N/A	NO	BKG
7440-47-3	CHROMIUM	10.2	J	43.2		ug/L	S23MW02S01	4/10	6.2	43.2	49.9	N/A	N/A	NO	BKG
7440-48-4	COBALT	4.5	J	6.4	J	ug/L	S23MW02S01,	4/10	4.2 - 5.2	6.4	48.6	N/A	N/A	NO	BKG
7440-50-8	COPPER	6.8	J	10.7	J	ug/L	S23MW02S01	2/10	6.8	10.7	107	48	N/A	NO	BSL, BKG
7439-89-6	IRON	202		24800		ug/L	S23MW02S01	9/10	175	24800	28200	N/A	N/A	NO	BKG
7439-92-1	LEAD	1.9	J	31.2		ug/L	S23MW02S01	5/10	1.8	31.2	6.63	13	N/A	YES	ASL
7439-95-4	MAGNESIUM	1610		7840		ug/L	S23MW02S01	9/10	544	7840	191000	N/A	N/A	NO	BKG
7439-96-5	MANGANESE	41.4	J	3380		ug/L	S23MW02S01	8/10	8.8 - 12.1	3380	11700	N/A	N/A	NO	BKG
7440-02-0	NICKEL	10	J	33.5		ug/L	S23MW02S01	2/10	9.2 - 9.9	33.5	32.2	880	N/A	NO	BSL
7440-09-7	POTASSIUM	1170		7790		ug/L	S23MW02S01	10/10	N/A	7790	70800	N/A	N/A	NO	BKG
7440-23-5	SODIUM	7790	J	99200	J	ug/L	S23HNUS201	10/10	N/A	99200	1900000	N/A	N/A	NO	BKG
7440-62-2	VANADIUM	6.4	J	6.4	J	ug/L	S23MW03D01	1/10	6.3 - 8.2	6.4	10.2	N/A	N/A	NO	BKG
7440-66-6	ZINC	68.4		68.4		ug/L	S23MW02S01	1/10	10.9 - 43.1	68.4	131	123	N/A	NO	BSL, BKG
Dissolved Metals															
7440-38-2	ARSENIC, FILTERED	3.1	J	3.1	J	ug/L	S23MW02S01-F	1/2	2.3	3.1	2.55	4	N/A	NO	BSL
7440-39-3	BARIUM, FILTERED	33.8		150		ug/L	S23MW02S01-F	2/2	N/A	150	124	N/A	N/A	NO	NTX
7440-70-2	CALCIUM, FILTERED	33000		45100		ug/L	S23MW02S01-F	2/2	N/A	45100	152000	N/A	N/A	NO	BKG
7439-89-6	IRON, FILTERED	4410		15400		ug/L	S23MW02S01-F	2/2	N/A	15400	25300	N/A	N/A	NO	BKG
7439-92-1	LEAD, FILTERED	10		10		ug/L	S23MW02S01-F	1/2	1.8	10	2.52	13	N/A	NO	BSL
7439-95-4	MAGNESIUM, FILTERED	3770		5830		ug/L	S23MW02S01-F	2/2	N/A	5830	150000	N/A	N/A	NO	BKG
7439-96-5	MANGANESE, FILTERED	977		2650		ug/L	S23MW02S01-F	2/2	N/A	2650	9400	N/A	N/A	NO	BKG
7440-09-7	POTASSIUM, FILTERED	5500		7340		ug/L	S23MW02S01-F	2/2	N/A	7340	60000	N/A	N/A	NO	BKG
7440-23-5	SODIUM, FILTERED	49300		82600	J	ug/L	S23HNUS201-F	2/2	N/A	82600	1580000	N/A	N/A	NO	BKG
Miscellaneous Parameters															
E-14506	ALKALINITY	18		348		mg/L	S23MW03D01	10/10	N/A	348	1950	N/A	N/A	NO	BKG
7664-41-7	AMMONIA	0.16	J	0.54	J	mg/L	S23HNUS201	3/3	N/A	0.54	ND	N/A	N/A	NO	NTX
7664-41-7	AMMONIA, AS NITROGEN	0.13	J	6.9	J	mg/L	S23MW02S01	6/7	100	6.9	ND	N/A	N/A	NO	NTX
000-02-0	CHLORIDE	6.55		124		mg/L	S23MW02S01	10/10	N/A	124	4540	N/A	N/A	NO	BKG

TABLE 13-5

OCCURRENCE, DISTRIBUITON, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN FOR GROUNDWATER AT SITE 23
MIGRATION PATHWAYS
BASEWIDE GROUNDWATER OPERABLE UNIT REMEDIAL INVESTIGATION
NSB-NLON, GROTON, CONECTICUT
PAGE 2 OF 2

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tank Farm (Site 23)

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	CTDEP Surface Water Criteria(5)	CTDEP Vol. Criteria(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
E-11778	HARDNESS as CaCO3	22.3		257		mg/L	S23MW03D01	10/10	N/A	257	ND	N/A	N/A	NO	NTX
14808-79-8	SULFATE	7.6		47.2		mg/L	S23HNUS2001	10/10	N/A	47.2	45.2	N/A	N/A	NO	NTX
000-09-0	TOTAL DISSOLVED SOLIDS	66.2		519	J	mg/L	S23MW02S01	10/10	N/A	519	6260	N/A	N/A	NO	BKG
7440-44-0	TOTAL ORGANIC CARBON	1	J	9		mg/L	S23MW04S01	10/10	N/A	9	37.7	N/A	N/A	NO	BKG
000-08-9	TOTAL SUSPENDED SOLIDS	6	J	169	J	mg/L	S23MW02S01	6/10	5000	169	236	N/A	N/A	NO	BKG

A shaded value indicates that the concentration used for screening exceeds the criterion or background value.
A shaded chemical name indicates that the chemical has been selected as a COPC.

Footnotes:

1 Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 95% Upper Tolerance Limit (UTL) of site background data.
5 Connecticut DEP Surface Water Protection criteria.
6 Connecticut DEP Volatilization criteria for residential exposures.
7 The chemical is selected as a COPC if the maximum detected concentration exceeds the CTDEP surface water protection or volatilization criteria.

Associated Samples:

S23HNUS1101	S23MW02D01	S23MW04S01
S23HNUS1301	S23MW02D01-D	
S23HNUS2001	S23MW02S01	
S23HNUS201	S23MW02S01-F	
S23HNUS201-F	S23MW03D01	
S23HNUS501	S23MW04D01	

Definitions:

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered.
C = Carcinogen.
COC = Chemical of Concern.
J = Estimated Value.
N = Noncarcinogen.
NA = Not Applicable.

Rationale Codes:

For Selection as a COPC:
ASL = Above COPC Screening Level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within Background Levels.
BSL = Below COPC Screening Level/ARAR/TBC.
NTX = No Toxicity Information.

TABLE 13-8

SUMMARY OF CANCER RISKS AND HAZARD INDICES FOR SITE 23
REASONABLE MAXIMUM EXPOSURES
BASEWIDE GROUNDWATER OPERABLE UNIT REMEDIAL INVESTIGATION
NSB-NLON, GROTON, CONNECTICUT

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals with HI > 1
Construction Worker	Groundwater	Dermal Contact	1.3E-09	- -	- -	- -	0.0002	- -
Adult Resident	Groundwater	Ingestion	1.8E-06	- -	- -	Tetrachloroethene	0.01	- -
		Dermal Contact	8.5E-07	- -	- -	- -	0.005	- -
		Inhalation (1)	1.8E-06	- -	- -	Tetrachloroethene	0.008	- -
		Total	4.5E-06	- -	- -	Tetrachloroethene	0.02	- -

Notes:
1 - Inhalation risk is assumed to be equal to risk from ingestion for volatiles.

ATTACHMENT A.2

TABLES FROM STORM SEWER REHABILITATION

TABLE 1
GROTON STORM SEWER REHABILITATION PROJECT
UNDERDRAIN WATER SAMPLING FOR OIL/WATER SEPARATOR (OWS) DETERMINATION
MONTHLY SAMPLING RESULTS

	Sample # Date sampled	OWS-072500 7/25/2000	OWS-082300 8/23/2000	OWS-100400 10/4/2000	OWS-011701 1/17/2001		OWS-031501 3/15/2001		OWS-041901 4/19/2001		OWS-052301 5/23/2001		CTDEP RSR Surface Water Protection Criteria(1)	CTDEP RSR Groundwater Volatilization Criteria(2)
ANALYSIS	METHOD	RESULTS	RESULTS	RESULTS	RESULTS		RESULTS		RESULTS		RESULTS			
Fuel Type Fingerprint	8015	ND	ND	ND	NA		NA		E		E		NA	NA
PH	EPA 150.1	6.2 std. Units	6.3 std. Units	6.3 std. Units	NA		NA		6.23		6.64		NA	NA
Total petroleum hydrocarbons	418.1	1.1 mg/l	<1.0 mg/l	1.0 mg/l	NA		NA		5.2 mg/l		0.08 mg/l		NA	NA
Oil and grease	EPA 413.1	<5.0 mg/l	<5.0 mg/l	<5.0 mg/l	NA		NA		9.2 mg/l		16 mg/l		NA	NA
Total suspended solids	EPA 160.2	62 mg/l	720 mg/l	1400 mg/l	<5.0 mg/l		23 mg/l		160 mg/l		273 mg/l		NA	NA
Metals:	6010B	NA	ug/l	ug/l	ug/l		ug/l		ug/l		ug/l		ug/l	
					Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved		
Aluminum		NA	11300	15500	1360	492	1670	ND	2150	16.5 B	2540	ND		
Antimony		NA	6.4	4.1	ND	ND	ND	ND	ND	ND	3.2B	ND	86000	NA
Arsenic		NA	**13.4**	**22.2**	ND	ND	**5.6 B**	ND	**8.1 B**	2.8 B	**9.1B**	ND	4	NA
Barium		NA	169	223	64.5 B	56.3 B	61.6 B	33.4 B	82.7 B	45.3 B	96.7B	38.3B	NA	NA
Beryllium		NA	2.6	0.3	ND	1.7 B	ND	ND	0.15 B	ND	0.98B	0.80B	4	NA
Cadmium		NA	0.8	0.8	ND	ND	ND	ND	ND	ND	ND	ND	6	NA
Calcium		NA	32500	35800	31100	29700	35400	31300	36600	33200	28200	28600	NA	NA
Chromium		NA	19.6	28.4	2.2 B	ND	2.4 B	ND	4.0 B	ND	6.5B	ND	110	NA
Cobalt		NA	9.9	17	2.4 B	ND	1.6 B	ND	3.2 B	ND	4.4B	ND	NA	NA
Copper		NA	36	39.5	ND	ND	6.1 B	ND	4.1 B	ND	10.6B	3.3B	48	NA
Iron		NA	62100	116000	15100	11100	24100	76.6 B	32600	258	62500	125	NA	NA
Lead		NA	**79.7**	**93.7**	**13.2**	7.9	11.1	ND	**16.7**	ND	**28.5**	ND	13	NA
Magnesium		NA	9950	12000	7350	6560	8350	6850	8950	7560	6620	6400	NA	NA
Manganese		NA	1540	2220	884	801	896	582	1150	515	1630	476	NA	NA
Mercury		NA	0.1	0.2	ND	ND	ND	ND	ND	ND	ND	0.25	0.4	NA
Nickel		NA	13.2	18.3	ND	ND	ND	3.3 B	ND	ND	ND	ND	880	NA
Potassium		NA	8600	9060	5430	5100	7100	4770 B	6400	5090	4270B	4330B	NA	NA
Selenium		NA	2.2	12.5	ND	ND	ND	ND	ND	ND	5.4	ND	50	NA
Silver		NA	2.8	4	ND	ND	ND	ND	ND	ND	1.9B	ND	12	NA
Sodium		NA	39500	51800	41800	37500	46100	39700	48400	44700	40400	45400	NA	NA
Thallium		NA	3.2	3.2	ND	ND	ND	ND	ND	ND	ND	3.9B	63	NA
Vanadium		NA	40.5	52.7	4.0 B	ND	8.7 B	ND	ND	ND	ND	ND	NA	NA
Zinc		NA	**228**	**231**	53.5	43.5	48.5	7.0 B	58.1	23.1	87.9	44.0	123	NA
Cyanide		NA	NR	NR	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VOA	OLM2.1													
Tetrachloroethene					ND		ND		ND		0.5J		88	340
VOA (TIC)	OLM2.1													
Methane, chlorodifluoro-					4.0 J		ND		ND		ND		NA	NA
Ethane, 1,1,2-trichloro-1,2,					2.9 J		ND		8.5 J		1.1 J		NA	NA
SVOA	8270C													
Dimethylphthalate					ND		ND		ND		1.1		NA	NA
Diethylphthalate					ND		ND		ND		20		NA	NA
Di-n-butylphthalate					ND		ND		ND		10		NA	NA
Bis(2-Ethylhexyl)phthalate					ND		ND		ND		20		59	NA
PAH	8310													
Naphthalene					ND		ND		ND		0.37J		NA	NA
Phenanthrene					**8.00**		ND		ND		**0.58**		0.3	NA
Fluoranthene					3.00		ND		ND		0.58		3700	NA
Pyrene					ND		ND		ND		0.52		110000	NA
Benzo(a)anthracene					ND		ND		ND		0.25J		0.3	NA
Chrysene					ND		ND		ND		0.21J		NA	NA
Benzo(b)fluoranthene					ND		ND		ND		**0.45J**		0.3	NA
Benzo(k)fluoranthene					ND		ND		ND		**2.00**		0.3	NA
Benzo(a)pyrene					ND		ND		ND		0.62		NA	NA
Dibenzo(a,h)anthracene					ND		ND		ND		0.50		NA	NA
Benzo(ghi)perylene					ND		ND		ND		0.62		NA	NA

Notes:
ND = Not Detected
NA = Not Analyzed
NR = Not reported
J = Indicates an estimated value
B = Indicates the analyte was found in the blank as well as the sample
E = No Calibrated Fuel Type Detected
Pesticide/PCB compounds were not detected (Method OLM2.1)
1 - CTDEP Remediation Standard Regulations, Residential, 1996.
2 - Connecticut's Proposed Revisions Remediation Standard Regulations, Volatilization Criteria, March 2003.
Shading indicates that concentration exceeds the screening criteria.

ATTACHMENT A.3

RISKS BASED ON STORM SEWER REHABILIATION

GROUNDWATER ANALYTICAL SAMPLING RESULTS

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Workers	Adult	Site 23	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	U.S. EPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	3300	cm2	U.S. EPA, 2004	
				EV	Event Frequency	1	events/day	(1)	DAevent x EV x EF x ED x SA
				ET	Exposure Time	4	hours/day	(1)	BW x AT
				EF	Exposure Frequency	30	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	See text for calculation of DAevent.
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	U.S. EPA, 1989	

Sources:

1 - Professional judgment.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = NA

Noncancer Ingestion Intake = NA

Cancer Dermal Intake = 5.54E-02

Noncancer Dermal Intake = 3.87E+00

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	Site 23	CA	Chemical concentration in air	Calculated	mg/m3	VDEQ, 2004	Intake (mg/kg/day) =
				CW	Chemical concentration in water.	Average	ug/L		
				CF	Conversion Factor	0.001	mg/ug	--	CA x IR x ET x EF x ED
				IR	Inhalation Rate	2.5	m3/hour	U.S. EPA, 1993	BW x AT
				ET	Exposure Time	4	hours/day	(1)	
				EF	Exposure Frequency	30	days/year	(1)	CA = CW x CF x VF
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	U.S. EPA, 1989	
				VF	Volatilization Factor	Calculated	(mg/m3)/(mg/L)	VDEQ, 2004	

Notes:

1 - Professional judgment.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

VDEQ, 2004: Virginia Department of Environmental Quality (VDEQ, online- http://www.deq.state.va.us/vrprisk/homepage.html).

Unit Intake Calculations

Inhalation Intake = (IR x ET x EF x ED)/(BW x AT)

Cancer Inhalation Intake = 1.68E-04 Noncancer Inhalation Intake = 1.17E-02

TABLE 4.3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Child	Site 23	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	U.S. EPA, 2002a	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	1.5	L/day	U.S. EPA, 1994	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	U.S. EPA, 1994	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	U.S. EPA, 1989	
				ED2	Exposure Duration (Age 2 - 6)	4	years	U.S. EPA, 1989	
				BW	Body Weight	15	kg	U.S. EPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2190	days	U.S. EPA, 1989	
Dermal	Residents	Child	Site 23	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	U.S. EPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	6,600	cm2	U.S. EPA, 2004	
				EV	Event Frequency	1	events/day	U.S. EPA, 2004	DAevent x EV x EF x ED x SA
				ET	Exposure Time	0.25	hours/day	U.S. EPA, 1997	BW x AT
				EF	Exposure Frequency	350	days/year	U.S. EPA, 1994	
				ED1	Exposure Duration (Age 0 - 2)	2	years	U.S. EPA, 1989	See text for calculation of DAevent.
				ED2	Exposure Duration (Age 2 - 6)	4	years	U.S. EPA, 1989	
				BW	Body Weight	15	kg	U.S. EPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2190	days	U.S. EPA, 1989	

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

U.S. EPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

U.S. EPA, 1994: U.S. EPA Region I Risk Updates, August 1994.

U.S. EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa

U.S. EPA, 2002:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake (Age 0 - 2) = 2.74E-06

Cancer Ingestion Intake (Age 2 - 6) = 5.48E-06

Cancer Dermal Intake (Age 0 - 2) = 1.21E+01

Cancer Dermal Intake (Age 2 - 6) = 2.41E+01

Noncancer Ingestion Intake = 9.59E-05

Noncancer Dermal Intake = 4.22E+02

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	Site 23	CGW	Chemical Concentration in Groundwater	95% UCL or Max	ug/L	U.S. EPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	2	L/day	U.S. EPA, 1994	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	U.S. EPA, 1994	BW x AT
				ED1	Exposure Duration (Age 10 - 16)	10	years	U.S. EPA, 1989	
				ED2	Exposure Duration (Age 16 - 30)	14	years	U.S. EPA, 1989	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	U.S. EPA, 1989	
Dermal	Residents	Adult	Site 23	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	U.S. EPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	18,000	cm2	U.S. EPA, 2004	
				EV	Event Frequency	1	events/day	U.S. EPA, 2004	DAevent x EV x EF x ED x SA
				ET	Exposure Time	0.25	hours/day	U.S. EPA, 2004	BW x AT
				EF	Exposure Frequency	350	days/year	U.S. EPA, 1994	
				ED1	Exposure Duration (Age 10 - 16)	10	years	U.S. EPA, 1989	See text for calculation of DAevent.
				ED2	Exposure Duration (Age 16 - 30)	14	years	U.S. EPA, 1989	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	U.S. EPA, 1989	

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

U.S. EPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

U.S. EPA, 1994: U.S. EPA Region I Risk Updates, August 1994.

U.S. EPA, 1997: Exposure Factors Handbook. U.S. EPA/600/8-95/002FA.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake Age 10 - 16) = 3.91E-06

Cancer Ingestion Intake Age 16 - 30) = 5.48E-06

Cancer Dermal Intake Age 10 - 16) = 3.52E+01

Cancer Dermal Intake (Age 16 - 30) = 4.93E+01

Noncancer Ingestion Intake = 6.58E-05

Noncancer Dermal Intake = 5.92E+02

TABLE 4.5
INTERMEDIATE VARIABLES FOR CALCULATING DA(EVENT)
SITE 23 - STORM SEWER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Potential Concern	Media	Dermal Absorption Fraction (soil)	FA	Kp		T(event)		Tau		T*		B
			Value	Value	Units	Value	Units	Value	Units	Value	Units	Value
Volatile Organic Compounds												
Tetrachloroethene	Groundwater	NA	1	3.3E-02	cm/hr	4	hr	9.1E-01	hr	2.2E+00	hr	1.7E-01
Semivolatile Organic Compounds												
Benzo(a)anthracene[1]	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene[1]	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene[1]	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene[1]	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene[1]	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-Ethylhexyl)phthalate	Groundwater	NA	0.8	2.5E-02	cm/hr	4	hr	1.7E+01	hr	4.0E+01	hr	1.9E-01
Chrysene[1]	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene[1]	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	Groundwater	NA	1	3.9E-03	cm/hr	4	hr	1.9E+00	hr	4.5E+00	hr	2.2E-02
Dimethylphthalate	Groundwater	NA	1	1.4E-03	cm/hr	4	hr	1.3E+00	hr	3.1E+00	hr	7.4E-03
Di-n-butylphthalate	Groundwater	NA	0.9	2.4E-02	cm/hr	4	hr	3.9E+00	hr	9.3E+00	hr	1.5E-01
Fluoranthene[1]	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Groundwater	NA	1	4.7E-02	cm/hr	4	hr	5.6E-01	hr	1.3E+00	hr	2.0E-01
Phenanthrene[1]	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	Groundwater	NA	1	1.9E-01	cm/hr	4	hr	1.4E+00	hr	5.5E+00	hr	1.1E+00
Inorganics												
Aluminum	Groundwater	NA	1	1.0E-03	cm/hr	4	hr	NA	NA	NA	NA	NA
Antimony	Groundwater	NA	1	1.0E-03	cm/hr	4	hr	NA	NA	NA	NA	NA
Arsenic	Groundwater	NA	1	1.0E-03	cm/hr	4	hr	NA	NA	NA	NA	NA
Barium	Groundwater	NA	1	1.0E-03	cm/hr	4	hr	NA	NA	NA	NA	NA
Beryllium	Groundwater	NA	1	1.0E-03	cm/hr	4	hr	NA	NA	NA	NA	NA
Chromium	Groundwater	NA	1	2.0E-03	cm/hr	4	hr	NA	NA	NA	NA	NA
Cobalt	Groundwater	NA	1	1.0E-03	cm/hr	4	hr	NA	NA	NA	NA	NA
Copper	Groundwater	NA	1	1.0E-03	cm/hr	4	hr	NA	NA	NA	NA	NA
Iron	Groundwater	NA	1	1.0E-03	cm/hr	4	hr	NA	NA	NA	NA	NA
Manganese	Groundwater	NA	1	1.0E-03	cm/hr	4	hr	NA	NA	NA	NA	NA
Selenium	Groundwater	NA	1	1.0E-03	cm/hr	4	hr	NA	NA	NA	NA	NA
Silver	Groundwater	NA	1	6.0E-04	cm/hr	4	hr	NA	NA	NA	NA	NA
Zinc	Groundwater	NA	1	6.0E-04	cm/hr	4	hr	NA	NA	NA	NA	NA

Notes:
All values from EPA's Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, July 2004.
1 - RAGS Part E recommends that dermal exposures to PAHs in water should not be quantitatively evaluated in the risk assessment.
FA = Fraction Absorbed Water
Kp = Dermal Permeability Coefficient of Compound in Water
T(event) = Event Duration
Tau = Lag Time
T* = Time to Reach Steady-State
B = Dimensionless Ratio of the Permeability Coefficient of a Compound Through the Stratum Corneum Relative to its Permeability Coefficient Across the Viable Epidermis
NA = Not applicable.

TABLE 5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 23 - STORM SEWER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds										
Tetrachloroethene	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	1000/1	IRS	4/23/2008
Semivolatile Organic Compounds										
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene[3]	Chronic	3.0E-02	mg/kg/day	1	3.0E-02	mg/kg/day	Kidney	3000/1	IRIS	4/23/2008
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Liver	1000/1	IRIS	4/23/2008
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	Chronic	8.0E-01	mg/kg/day	1	8.0E-01	mg/kg/day	Body Weight	1000/1	IRIS	4/23/2008
Dimethylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	Chronic	1.0E-01	mg/kg/day	1	1.0E-01	mg/kg/day	Mortality	1000/1	IRIS	4/23/2008
Fluoranthene	Chronic	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	Liver	3000/1	IRIS	4/23/2008
Naphthalene	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Body Weight	3000/1	IRIS	4/23/2008
Phenanthrene[3]	Chronic	3.0E-02	mg/kg/day	1	3.0E-02	mg/kg/day	Kidney	3000/1	IRIS	4/23/2008
Pyrene	Chronic	3.0E-02	mg/kg/day	1	3.0E-02	mg/kg/day	Kidney	3000/1	IRIS	4/23/2008
Inorganics										
Aluminum	Chronic	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	CNS	100	PPRTV	10/23/2006
Antimony	Chronic	4.0E-04	mg/kg/day	0.15	6.0E-05	mg/kg/day	Blood	1000/1	IRIS	4/23/2008
Arsenic	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, CVS	3/1	IRIS	4/23/2008
Barium	Chronic	2.0E-01	mg/kg/day	0.07	1.4E-02	mg/kg/day	Kidney	300/1	IRIS	4/23/2008
Beryllium	Chronic	2.0E-03	mg/kg/day	0.007	1.4E-05	mg/kg/day	GS	300/1	IRIS	4/23/2008
Chromium	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	Fetotoxicity, GS, Bone	300/3	IRIS	4/23/2008
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	Chronic	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	GS	NA	HEAST	7/1997
Iron	Chronic	7.0E-01	mg/kg/day	1	7.0E-01	mg/kg/day	GS	1.5	PPRTV	9/11/2006
Manganese	Chronic	2.4E-02	mg/kg/day	0.04	9.6E-04	mg/kg/day	CNS	1/3	IRIS	4/23/2008
Selenium	Chronic	5.0E-03	mg/kg/day	1	5.0E-03	mg/kg/day	Skin	3/1	IRIS	4/23/2008
Silver	Chronic	5.0E-03	mg/kg/day	0.04	2.0E-04	mg/kg/day	Skin	3/1	IRIS	4/23/2008
Zinc	Chronic	3.0E-01	mg/kg/day	1	3.0E-01	mg/kg/day	Blood	3/1	IRIS	4/23/2008

Notes:
1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.
3 - Values are for pyrene.

Definitions:
CNS = Central Nervous System
CVS = Cardiovascular system
USEPA(1) = Draft Trichloroethylene Health Risk Assessment: Synthesis and Characterization, August 2001.
USEPA III = U.S. EPA Region 3 RBC Table, October 11, 2007.
GS = Gastrointestinal system
IRIS = Integrated Risk Information System
NA = Not Applicable

TABLE 5.2
NON-CANCER TOXICITY DATA -- INHALATION
SITE 23 - STORM SEWER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds									
Tetrachloroethene	Chronic	2.8E-01	mg/m^3	8.0E-02	(mg/kg/day)	Liver	NA	USEPA III	10/11/2007
Semivolatile Organic Compounds									
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	3.0E-03	mg/m^3	8.6E-04	(mg/kg/day)	Nasal	3000/1	IRIS	4/23/2008
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics									
Aluminum	Chronic	0.005	mg/m3	1.4E-03	(mg/kg/day)	CNS	300	PPRTV	10/23/2006
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	Chronic	5.0E-04	mg/m3	1.4E-04	(mg/kg/day)	Fetotoxicity	1000	HEAST	7/97
Beryllium	Chronic	2.0E-05	mg/m3	5.7E-06	(mg/kg/day)	GS	10/1	IRIS	4/23/2008
Chromium	Chronic	1.0E-04	mg/m^3	2.9E-05	(mg/kg/day)	Lungs	300/1	IRIS	4/23/2008
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Chronic	5.0E-05	mg/m^3	1.4E-05	(mg/kg/day)	CNS	1000/1	IRIS	4/23/2008
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1 - Extrapolated RfD = RfC $*20m^3$/day / 70 kg

Definitions:
CNS = Central Nervous System
USEPA III = U.S. EPA Region 3 RBC Table, October 11, 2007.
GS = Gastrointestinal
HEAST= Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
NA = Not Applicable

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 23 - STORM SEWER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal(1)	Absorbed Cancer Slope Factor for Dermal(2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds								
Tetrachloroethene	5.4E-01	(mg/kg/day)-1	1	5.4E-01	(mg/kg/day)-1	NA	IRIS	4/23/2008
Semivolatile Organic Compounds								
Benzo(a)anthracene	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
Benzo(a)pyrene	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	IRIS	7/20/2007
Benzo(b)fluoranthene	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	D	IRIS	
Benzo(k)fluoranthene	7.3E-02	$(mg/kg/day)^{-1}$	1	7.3E-02	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
Bis(2-ethylhexyl)phthalate	1.4E-02	$(mg/kg/day)^{-1}$	1	1.4E-02	$(mg/kg/day)^{-1}$	B2	IRIS	4/23/2008
Chrysene	7.3E-03	$(mg/kg/day)^{-1}$	1	7.3E-03	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
Dibenzo(a,h)anthracene	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
Diethylphthalate	NA	NA	NA	NA	NA	D	IRIS	4/23/2008
Dimethylphthalate	NA	NA	NA	NA	NA	D	IRIS	4/23/2008
Di-n-butylphthalate	NA	NA	NA	NA	NA	D	IRIS	4/23/2008
Fluoranthene	NA	NA	NA	NA	NA	D	IRIS	4/23/2008
Naphthalene	NA	NA	NA	NA	NA	C	IRIS	4/23/2008
Phenanthrene	NA	NA	NA	NA	NA	D	IRIS	4/23/2008
Pyrene	NA	NA	NA	NA	NA	D	IRIS	4/23/2008
Inorganics								
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A	IRIS	4/23/2008
Barium	NA	NA	NA	NA	NA	D	IRIS	4/23/2008
Beryllium	NA	NA	NA	NA	NA	B1	IRIS	4/23/2008
Chromium	NA	NA	NA	NA	NA	D	IRIS	4/23/2008
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	D	IRIS	4/23/2008
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	D	IRIS	4/23/2008
Selenium	NA	NA	NA	NA	NA	D	IRIS	4/23/2008
Silver	NA	NA	NA	NA	NA	D	IRIS	4/23/2008
Zinc	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency for Dermal.
USEPA III = U.S. EPA Region 3 RBC Table, October 11, 2007.
IRIS = Integrated Risk Information System.
NA = Not Available.

EPA Group:
A - Human carcinogen.
B1 - Probable human carcinogen - indicates that limited human data are available.
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .
C - Possible human carcinogen.
D - Not classifiable as a human carcinogen.
E - Evidence of noncarcinogenicity.

USEPA(1) = U.S. EPA, Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, July 1993, EPA/600/R-93/089.

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
SITE 23 - STORM SEWER
NSB-NLON, GROTON, CONNECTICUT

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor[1]		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds							
Tetrachloroethene	5.7E-06	$(ug/m^3)^{-1}$	2.0E-02	$(mg/kg/day)^{-1}$	NA	USEPA III	10/11/2007
Semivolatile Organic Compounds							
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	8.9E-04	$(ug/m^3)^{-1}$	3.1E+00	$(mg/kg/day)^{-1}$	NA	USEPA III	10/11/2007
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA	NA	D	IRIS	4/23/2008
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA
Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	B2	IRIS	4/23/2008
Chrysene	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	NA	NA	NA	NA	D	IRIS	4/23/2008
Dimethylphthalate	NA	NA	NA	NA	D	IRIS	4/23/2008
Di-n-butylphthalate	NA	NA	NA	NA	D	IRIS	4/23/2008
Fluoranthene	NA	NA	NA	NA	D	IRIS	4/23/2008
Naphthalene	NA	NA	NA	NA	C	IRIS	4/23/2008
Phenanthrene	NA	NA	NA	NA	D	IRIS	4/23/2008
Pyrene	NA	NA	NA	NA	D	IRIS	4/23/2008
Inorganics							
Aluminum	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA
Arsenic	4.3E-03	$(ug/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A	IRIS	4/23/2008
Barium	NA	NA	NA	NA	D	IRIS	4/23/2008
Beryllium	2.4E-03	$(ug/m^3)^{-1}$	8.4E+00	$(mg/kg/day)^{-1}$	B1	IRIS	4/23/2008
Chromium	1.2E-02	$(ug/m^3)^{-1}$	4.2E+01	$(mg/kg/day)^{-1}$	A	IRIS	4/23/2008
Cobalt	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	D	IRIS	4/23/2008
Iron	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	D	IRIS	4/23/2008
Selenium	NA	NA	NA	NA	D	IRIS	4/23/2008
Silver	NA	NA	NA	NA	D	IRIS	4/23/2008
Zinc	NA	NA	NA	NA	D	IRIS	4/23/2008

Notes:
1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.
Definitions:
IRIS = Integrated Risk Information System.
NA = Not Available.
USEPA III = U.S. EPA Region 3 RBC Table, October 11, 2007.

EPA Group:
A - Human carcinogen.
B1 - Probable human carcinogen - indicates that limited human data are available.
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .
C - Possible human carcinogen.
D - Not classifiable as a human carcinogen.
E - Evidence of noncarcinogenicity.

TABLE 7.1.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site 23	Dermal	Aluminum	2540	ug/L	5.6E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	3.9E-05	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.00004
				Antimony	3.20	ug/L	7.1E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	5.0E-08	(mg/kg/day)	6.0E-05	(mg/kg/day)	0.0008
				Arsenic	9.10	ug/L	2.0E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.0E-09	1.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0005
				Barium	96.7	ug/L	2.1E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	1.5E-06	(mg/kg/day)	1.4E-02	(mg/kg/day)	0.0001
				Beryllium	0.980	ug/L	2.2E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	1.5E-08	(mg/kg/day)	1.4E-05	(mg/kg/day)	0.001
				Chromium	6.50	ug/L	2.9E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	2.0E-07	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.003
				Cobalt	4.40	ug/L	9.7E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	6.8E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Copper	10.6	ug/L	2.3E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	1.6E-07	(mg/kg/day)	4.0E-02	(mg/kg/day)	0.000004
				Iron	62500	ug/L	1.4E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	9.7E-04	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.001
				Manganese	1630	ug/L	3.6E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	2.5E-05	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.03
				Selenium	5.40	ug/L	1.2E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	8.4E-08	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.00002
				Silver	1.90	ug/L	2.5E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	1.8E-08	(mg/kg/day)	2.0E-04	(mg/kg/day)	0.00009
				Zinc	87.9	ug/L	1.2E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	8.2E-07	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.000003
				Tetrachloroethene	0.500	ug/L	5.1E-09	(mg/kg/day)	5.4E-01	$(mg/kg/day)^{-1}$	2.8E-09	3.6E-07	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.00004
				Dimethylphthalate	1.10	ug/L	5.6E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	3.9E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Diethylphthalate	20.0	ug/L	3.3E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	2.3E-06	(mg/kg/day)	8.0E-01	(mg/kg/day)	0.000003
				Di-n-butylphthalate	10.0	ug/L	1.3E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	9.1E-06	(mg/kg/day)	1.0E-01	(mg/kg/day)	0.00009
				Bis(2-Ethylhexyl)phthalate	20.0	ug/L	5.0E-07	(mg/kg/day)	1.4E-02	$(mg/kg/day)^{-1}$	7.0E-09	3.5E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.002
				Naphthalene	0.370	ug/L	4.5E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	3.1E-07	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.00002
				Phenanthrene	0.580	ug/L	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Fluoranthene	0.580	ug/L	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	4.0E-02	(mg/kg/day)	--
				Pyrene	0.520	ug/L	3.7E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	2.6E-06	(mg/kg/day)	3.0E-02	(mg/kg/day)	0.00009
				Benzo(a)anthracene	0.250	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Chrysene	0.210	ug/L	0.0E+00	(mg/kg/day)	7.3E-03	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.450	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	2.00	ug/L	0.0E+00	(mg/kg/day)	7.3E-02	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.620	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.500	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(g,h,i)perylene	0.620	ug/L	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.3E-08					0.04
		Exposure Point Total									1.3E-08					0.04
	Exposure Medium Total										1.3E-08					0.04

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				Hazard Quotient
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Air	Site 23	Inhalation	Aluminum	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	1.4E-03	(mg/kg/day)	--
				Antimony	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	1.5E+01	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Barium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	1.4E-04	(mg/kg/day)	--
				Beryllium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	8.4E+00	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	5.7E-06	(mg/kg/day)	--
				Chromium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	4.2E+01	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	2.9E-05	(mg/kg/day)	--
				Cobalt	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Copper	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Iron	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	1.4E-05	(mg/kg/day)	--
				Selenium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Silver	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Zinc	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Tetrachloroethene	1.4E-5	mg/m3	2.4E-09	(mg/kg/day)	2.0E-02	$(mg/kg/day)^{-1}$	4.8E-11	1.7E-07	(mg/kg/day)	8.0E-02	(mg/kg/day)	0.000002
				Dimethylphthalate	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Diethylphthalate	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Di-n-butylphthalate	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Bis(2-Ethylhexyl)phthalate	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Naphthalene	1.1E-5	mg/m3	1.8E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	1.3E-07	(mg/kg/day)	8.6E-04	(mg/kg/day)	0.0001
				Phenanthrene	1.5E-5	mg/m3	2.6E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	1.8E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Fluoranthene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Pyrene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)anthracene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Chrysene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	3.1E+00	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(g,h,i)perylene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								4.8E-11					0.0002
		Exposure Point Total									4.8E-11					0.0002
	Exposure Medium Total										4.8E-11					0.0002
Medium Total											1.3E-08					0.04
										Total of Receptor Risks Across All Media	1.3E-08				Total of Receptor Hazards Across All Media	0.04

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site 23	Ingestion	Aluminum	2540	ug/L	2.1E-02	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.4E-01	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.2
				Antimony	3.20	ug/L	2.6E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.1E-04	(mg/kg/day)	4.0E-04	(mg/kg/day)	0.8
				Arsenic	9.10	ug/L	7.5E-05	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1.1E-04	8.7E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	2.9
				Barium	96.7	ug/L	7.9E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	9.3E-03	(mg/kg/day)	2.0E-01	(mg/kg/day)	0.05
				Beryllium	0.980	ug/L	8.1E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	9.4E-05	(mg/kg/day)	2.0E-03	(mg/kg/day)	0.05
				Chromium	6.50	ug/L	5.3E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	6.2E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.2
				Cobalt	4.40	ug/L	3.6E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	4.2E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Copper	10.6	ug/L	8.7E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.0E-03	(mg/kg/day)	4.0E-02	(mg/kg/day)	0.03
				Iron	62500	ug/L	5.1E-01	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	6.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	8.6
				Manganese	1630	ug/L	1.3E-02	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.6E-01	(mg/kg/day)	2.4E-02	(mg/kg/day)	6.5
				Selenium	5.40	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.2E-04	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.1
				Silver	1.90	ug/L	1.6E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.8E-04	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.04
				Zinc	87.9	ug/L	7.2E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	8.4E-03	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.03
				Tetrachloroethene	0.500	ug/L	4.1E-06	(mg/kg/day)	5.4E-01	(mg/kg/day)$^{-1}$	2.2E-06	4.8E-05	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.005
				Dimethylphthalate	1.10	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.1E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Diethylphthalate	20.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.9E-03	(mg/kg/day)	8.0E-01	(mg/kg/day)	0.002
				Di-n-butylphthalate	10.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	9.6E-04	(mg/kg/day)	1.0E-01	(mg/kg/day)	0.010
				Bis(2-Ethylhexyl)phthalate	20.0	ug/L	1.6E-04	(mg/kg/day)	1.4E-02	(mg/kg/day)$^{-1}$	2.3E-06	1.9E-03	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.10
				Naphthalene	0.370	ug/L	3.0E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.5E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.002
				Phenanthrene	0.580	ug/L	4.8E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.6E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Fluoranthene	0.580	ug/L	4.8E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.6E-05	(mg/kg/day)	4.0E-02	(mg/kg/day)	0.001
				Pyrene	0.520	ug/L	4.3E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.0E-05	(mg/kg/day)	3.0E-02	(mg/kg/day)	0.002
				Benzo(a)anthracene	0.250	ug/L	1.1E-05	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	8.0E-06	2.4E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Chrysene	0.210	ug/L	1.7E-06	(mg/kg/day)	7.3E-03	(mg/kg/day)$^{-1}$	1.3E-08	2.0E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.450	ug/L	2.0E-05	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	1.4E-05	4.3E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	2.00	ug/L	8.8E-05	(mg/kg/day)	7.3E-02	(mg/kg/day)$^{-1}$	6.4E-06	1.9E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.620	ug/L	2.7E-05	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	2.0E-04	5.9E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.500	ug/L	2.2E-05	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	1.6E-04	4.8E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(g,h,i)perylene	0.620	ug/L	5.1E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.9E-05	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								5.0E-04					20
			Dermal	Aluminum	2540	ug/L	7.7E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.7E-04	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.0003
				Antimony	3.20	ug/L	9.6E-09	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.4E-07	(mg/kg/day)	6.0E-05	(mg/kg/day)	0.006
				Arsenic	9.10	ug/L	2.7E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	4.1E-08	9.6E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Barium	96.7	ug/L	2.9E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.0E-05	(mg/kg/day)	1.4E-02	(mg/kg/day)	0.0007
				Beryllium	0.980	ug/L	3.0E-09	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.0E-07	(mg/kg/day)	1.4E-05	(mg/kg/day)	0.007
				Chromium	6.50	ug/L	3.9E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.4E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.02
				Cobalt	4.40	ug/L	1.3E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	4.6E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Copper	10.6	ug/L	3.2E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.1E-06	(mg/kg/day)	4.0E-02	(mg/kg/day)	0.00003
				Iron	62500	ug/L	1.9E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	6.6E-03	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.009
				Manganese	1630	ug/L	4.9E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.7E-04	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.2
				Selenium	5.40	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.7E-07	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.0001
				Silver	1.90	ug/L	3.4E-09	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.2E-07	(mg/kg/day)	2.0E-04	(mg/kg/day)	0.0006
				Zinc	87.9	ug/L	1.6E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.6E-06	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.00002
				Tetrachloroethene	0.500	ug/L	2.7E-07	(mg/kg/day)	5.4E-01	(mg/kg/day)$^{-1}$	1.4E-07	9.3E-06	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.0009
				Dimethylphthalate	1.10	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.0E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Diethylphthalate	20.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	6.2E-05	(mg/kg/day)	8.0E-01	(mg/kg/day)	0.00008
				Di-n-butylphthalate	10.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.5E-04	(mg/kg/day)	1.0E-01	(mg/kg/day)	0.002
				Bis(2-Ethylhexyl)phthalate	20.0	ug/L	2.7E-05	(mg/kg/day)	1.4E-02	(mg/kg/day)$^{-1}$	3.8E-07	9.5E-04	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.05
				Naphthalene	0.370	ug/L	2.1E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	7.5E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0004
				Phenanthrene	0.580	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Fluoranthene	0.580	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-02	(mg/kg/day)	--
				Pyrene	0.520	ug/L	2.0E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	7.0E-05	(mg/kg/day)	3.0E-02	(mg/kg/day)	0.002
				Benzo(a)anthracene	0.250	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Chrysene	0.210	ug/L	0.0E+00	(mg/kg/day)	7.3E-03	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.450	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--

TABLE 7.2.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site 23	Dermal	Benzo(k)fluoranthene	2.00	ug/L	0.0E+00	(mg/kg/day)	7.3E-02	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.620	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.500	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(g,h,i)perylene	0.620	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total													
		Exposure Point Total									5.6E-07					0.3
	Exposure Medium Total										5.0E-04					20
											5.0E-04					20
Groundwater	Air	Site 23	Inhalation	Aluminum	2540	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Antimony	3.20	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-04	(mg/kg/day)	--
				Arsenic	9.10	ug/L	0.0E+00	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Barium	96.7	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.0E-01	(mg/kg/day)	--
				Beryllium	0.980	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.0E-03	(mg/kg/day)	--
				Chromium	6.50	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
				Cobalt	4.40	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Copper	10.6	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-02	(mg/kg/day)	--
				Iron	62500	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	1630	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.4E-02	(mg/kg/day)	--
				Selenium	5.40	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
				Silver	1.90	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
				Zinc	87.9	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-01	(mg/kg/day)	--
				Tetrachloroethene	0.500	ug/L	4.1E-06	(mg/kg/day)	5.4E-01	(mg/kg/day)$^{-1}$	2.2E-06	4.8E-05	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.005
				Dimethylphthalate	1.10	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Diethylphthalate	20.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	8.0E-01	(mg/kg/day)	--
				Di-n-butylphthalate	10.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-01	(mg/kg/day)	--
				Bis(2-Ethylhexyl)phthalate	20.0	ug/L	0.0E+00	(mg/kg/day)	1.4E-02	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.0E-02	(mg/kg/day)	--
				Naphthalene	0.370	ug/L	3.0E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.5E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.002
				Phenanthrene	0.580	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Fluoranthene	0.580	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-02	(mg/kg/day)	--
				Pyrene	0.520	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-02	(mg/kg/day)	--
				Benzo(a)anthracene	0.250	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Chrysene	0.210	ug/L	0.0E+00	(mg/kg/day)	7.3E-03	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.450	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	2.00	ug/L	0.0E+00	(mg/kg/day)	7.3E-02	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.620	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.500	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(g,h,i)perylene	0.620	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total													
		Exposure Point Total									2.2E-06					0.007
	Exposure Medium Total										2.2E-06					0.007
Medium Total											2.2E-06					0.007
											5.1E-04					20
									Total of Receptor Risks Across All Media		5.1E-04			Total of Receptor Hazards Across All Media		20

Note:
Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site 23	Ingestion	Aluminum	2540	ug/L	2.0E-02	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.7E-01	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.2
				Antimony	3.20	ug/L	2.5E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	2.1E-04	(mg/kg/day)	4.0E-04	(mg/kg/day)	0.5
				Arsenic	9.10	ug/L	7.1E-05	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1.1E-04	6.0E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	2.0
				Barium	96.7	ug/L	7.6E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	6.4E-03	(mg/kg/day)	2.0E-01	(mg/kg/day)	0.03
				Beryllium	0.980	ug/L	7.7E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	6.4E-05	(mg/kg/day)	2.0E-03	(mg/kg/day)	0.03
				Chromium	6.50	ug/L	5.1E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	4.3E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.1
				Cobalt	4.40	ug/L	3.4E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	2.9E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Copper	10.6	ug/L	8.3E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	7.0E-04	(mg/kg/day)	4.0E-02	(mg/kg/day)	0.02
				Iron	62500	ug/L	4.9E-01	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	4.1E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	5.9
				Manganese	1630	ug/L	1.3E-02	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.1E-01	(mg/kg/day)	2.4E-02	(mg/kg/day)	4.5
				Selenium	5.40	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	3.6E-04	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.07
				Silver	1.90	ug/L	1.5E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.2E-04	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.02
				Zinc	87.9	ug/L	6.9E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	5.8E-03	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.02
				Tetrachloroethene	0.500	ug/L	3.9E-06	(mg/kg/day)	5.4E-01	(mg/kg/day)$^{-1}$	2.1E-06	3.3E-05	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.003
				Dimethylphthalate	1.10	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	7.2E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Diethylphthalate	20.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.3E-03	(mg/kg/day)	8.0E-01	(mg/kg/day)	0.002
				Di-n-butylphthalate	10.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	6.6E-04	(mg/kg/day)	1.0E-01	(mg/kg/day)	0.007
				Bis(2-Ethylhexyl)phthalate	20.0	ug/L	1.6E-04	(mg/kg/day)	1.4E-02	(mg/kg/day)$^{-1}$	2.2E-06	1.3E-03	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.07
				Naphthalene	0.370	ug/L	2.9E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	2.4E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.001
				Phenanthrene	0.580	ug/L	4.5E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	3.8E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Fluoranthene	0.580	ug/L	4.5E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	3.8E-05	(mg/kg/day)	4.0E-02	(mg/kg/day)	0.0010
				Pyrene	0.520	ug/L	4.1E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	3.4E-05	(mg/kg/day)	3.0E-02	(mg/kg/day)	0.001
				Benzo(a)anthracene	0.250	ug/L	3.9E-06	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	2.9E-06	1.6E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Chrysene	0.210	ug/L	1.6E-06	(mg/kg/day)	7.3E-03	(mg/kg/day)$^{-1}$	1.2E-08	1.4E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.450	ug/L	7.0E-06	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	5.1E-06	3.0E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	2.00	ug/L	3.1E-05	(mg/kg/day)	7.3E-02	(mg/kg/day)$^{-1}$	2.3E-06	1.3E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.620	ug/L	9.7E-06	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	7.1E-05	4.1E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.500	ug/L	7.8E-06	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	5.7E-05	3.3E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(g,h,i)perylene	0.620	ug/L	4.9E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	4.1E-05	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								2.5E-04					13
			Dermal	Aluminum	2540	ug/L	5.4E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	3.8E-04	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.0004
				Antimony	3.20	ug/L	6.8E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	4.7E-07	(mg/kg/day)	6.0E-05	(mg/kg/day)	0.008
				Arsenic	9.10	ug/L	1.9E-07	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	2.9E-07	1.3E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.004
				Barium	96.7	ug/L	2.0E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.4E-05	(mg/kg/day)	1.4E-02	(mg/kg/day)	0.001
				Beryllium	0.980	ug/L	2.1E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.4E-07	(mg/kg/day)	1.4E-05	(mg/kg/day)	0.01
				Chromium	6.50	ug/L	2.7E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.9E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.03
				Cobalt	4.40	ug/L	9.3E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	6.5E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Copper	10.6	ug/L	2.2E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.6E-06	(mg/kg/day)	4.0E-02	(mg/kg/day)	0.00004
				Iron	62500	ug/L	1.3E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	9.2E-03	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.01
				Manganese	1630	ug/L	3.4E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	2.4E-04	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.3
				Selenium	5.40	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	8.0E-07	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.0002
				Silver	1.90	ug/L	2.4E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.7E-07	(mg/kg/day)	2.0E-04	(mg/kg/day)	0.0008
				Zinc	87.9	ug/L	1.1E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	7.8E-06	(mg/kg/day)	3.0E-01	(mg/kg/day)	0.00003
				Tetrachloroethene	0.500	ug/L	1.9E-06	(mg/kg/day)	5.4E-01	(mg/kg/day)$^{-1}$	1.0E-06	1.3E-05	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.001
				Dimethylphthalate	1.10	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.4E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Diethylphthalate	20.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	8.7E-05	(mg/kg/day)	8.0E-01	(mg/kg/day)	0.0001
				Di-n-butylphthalate	10.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	3.5E-04	(mg/kg/day)	1.0E-01	(mg/kg/day)	0.003
				Bis(2-Ethylhexyl)phthalate	20.0	ug/L	1.9E-04	(mg/kg/day)	1.4E-02	(mg/kg/day)$^{-1}$	2.7E-06	1.3E-03	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.07
				Naphthalene	0.370	ug/L	1.5E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.1E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0005
				Phenanthrene	0.580	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Fluoranthene	0.580	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	4.0E-02	(mg/kg/day)	--
				Pyrene	0.520	ug/L	1.4E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	9.9E-05	(mg/kg/day)	3.0E-02	(mg/kg/day)	0.003
				Benzo(a)anthracene	0.250	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Chrysene	0.210	ug/L	0.0E+00	(mg/kg/day)	7.3E-03	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.450	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site 23	Dermal	Benzo(k)fluoranthene	2.00	ug/L	0.0E+00	(mg/kg/day)	7.3E-02	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.620	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.500	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(g,h,i)perylene	0.620	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								4.0E-06					0.4
		Exposure Point Total									2.5E-04					14
	Exposure Medium Total										2.5E-04					14
Groundwater	Air	Site 23	Inhalation	Aluminum	2540	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Antimony	3.20	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-04	(mg/kg/day)	--
				Arsenic	9.10	ug/L	0.0E+00	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Barium	96.7	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.0E-01	(mg/kg/day)	--
				Beryllium	0.980	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.0E-03	(mg/kg/day)	--
				Chromium	6.50	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
				Cobalt	4.40	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Copper	10.6	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-02	(mg/kg/day)	--
				Iron	62500	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	1630	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.4E-02	(mg/kg/day)	--
				Selenium	5.40	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
				Silver	1.90	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
				Zinc	87.9	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-01	(mg/kg/day)	--
				Tetrachloroethene	0.500	ug/L	3.9E-06	(mg/kg/day)	5.4E-01	(mg/kg/day)$^{-1}$	2.1E-06	3.3E-05	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.003
				Dimethylphthalate	1.10	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Diethylphthalate	20.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	8.0E-01	(mg/kg/day)	--
				Di-n-butylphthalate	10.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-01	(mg/kg/day)	--
				Bis(2-Ethylhexyl)phthalate	20.0	ug/L	0.0E+00	(mg/kg/day)	1.4E-02	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.0E-02	(mg/kg/day)	--
				Naphthalene	0.370	ug/L	2.9E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.4E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.001
				Phenanthrene	0.580	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Fluoranthene	0.580	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-02	(mg/kg/day)	--
				Pyrene	0.520	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-02	(mg/kg/day)	--
				Benzo(a)anthracene	0.250	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Chrysene	0.210	ug/L	0.0E+00	(mg/kg/day)	7.3E-03	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.450	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	2.00	ug/L	0.0E+00	(mg/kg/day)	7.3E-02	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.620	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.500	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(g,h,i)perylene	0.620	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								2.1E-06					0.005
		Exposure Point Total									2.1E-06					0.005
	Exposure Medium Total										2.1E-06					0.005
Medium Total											2.6E-04					14
										Total of Receptor Risks Across All Media	2.6E-04				Total of Receptor Hazards Across All Media	14

Note:
Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Aluminum	- -	--	- -	--	- -	CNS	--	- -	0.00004	0.00004
			Antimony	- -	--	- -	--	- -	Blood	--	- -	0.0008	0.0008
			Arsenic	- -	--	3E-09	--	3E-09	Skin, CVS	--	- -	0.0005	0.0005
			Barium	- -	--	- -	--	- -	Kidney	--	- -	0.0001	0.0001
			Beryllium	- -	--	- -	--	- -	GS	--	- -	0.001	0.001
			Chromium	- -	--	- -	--	- -	Fetotoxicity, GS, Bone	--	- -	0.003	0.003
			Cobalt	- -	--	- -	--	- -	NA	--	- -	--	--
			Copper	- -	--	- -	--	- -	GS	--	- -	0.000004	0.000004
			Iron	- -	--	- -	--	- -	GS	--	- -	0.001	0.001
			Manganese	- -	--	- -	--	- -	CNS	--	- -	0.03	0.03
			Selenium	- -	--	- -	--	- -	Skin	--	- -	0.00002	0.00002
			Silver	- -	--	- -	--	- -	Skin	--	- -	0.00009	0.00009
			Zinc	- -	--	- -	--	- -	Blood	--	- -	0.000003	0.000003
			Tetrachloroethene	- -	--	3E-09	--	3E-09	Liver	--	- -	0.00004	0.00004
			Dimethylphthalate	- -	--	- -	--	- -	NA	--	- -	--	--
			Diethylphthalate	- -	--	- -	--	- -	Body Weight	--	- -	0.000003	0.000003
			Di-n-butylphthalate	- -	--	- -	--	- -	Mortality	--	- -	0.00009	0.00009
			Bis(2-Ethylhexyl)phthalate	- -	--	7E-09	--	7E-09	Liver	--	- -	0.002	0.002
			Naphthalene	- -	--	- -	--	- -	Body Weight	--	- -	0.00002	0.00002
			Phenanthrene	- -	--	- -	--	- -	Kidney	--	- -	--	--
			Fluoranthene	- -	--	- -	--	- -	Liver	--	- -	--	--
			Pyrene	- -	--	- -	--	- -	Kidney	--	- -	0.00009	0.00009
			Benzo(a)anthracene	- -	--	- -	--	- -	NA	--	- -	--	--
			Chrysene	- -	--	- -	--	- -	NA	--	- -	--	--
			Benzo(b)fluoranthene	- -	--	- -	--	- -	NA	--	- -	--	--
			Benzo(k)fluoranthene	- -	--	- -	--	- -	NA	--	- -	--	--
			Benzo(a)pyrene	- -	--	- -	--	- -	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	- -	--	- -	--	- -	NA	--	- -	--	--
			Benzo(g,h,i)perylene	- -	--	- -	--	- -	Kidney	--	- -	--	--
			Chemical Total	- -	--	1E-08	--	1E-08		--	- -	0.04	0.04
		Exposure Point Total						1E-08					0.04
	Exposure Medium Total							1E-08					0.04

5/15/2008

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Aluminum	--	--	--	--	--	CNS	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	--	--	--	--	NA	--	--	--	--
			Barium	--	--	--	--	--	Fetotoxicity	--	--	--	--
			Beryllium	--	--	--	--	--	GS	--	--	--	--
			Chromium	--	--	--	--	--	Lungs	--	--	--	--
			Cobalt	--	--	--	--	--	NA	--	--	--	--
			Copper	--	--	--	--	--	NA	--	--	--	--
			Iron	--	--	--	--	--	NA	--	--	--	--
			Manganese	--	--	--	--	--	CNS	--	--	--	--
			Selenium	--	--	--	--	--	NA	--	--	--	--
			Silver	--	--	--	--	--	NA	--	--	--	--
			Zinc	--	--	--	--	--	NA	--	--	--	--
			Tetrachloroethene	--	5E-11	--	--	5E-11	Liver	--	0.000002	--	0.000002
			Dimethylphthalate	--	--	--	--	--	NA	--	--	--	--
			Diethylphthalate	--	--	--	--	--	NA	--	--	--	--
			Di-n-butylphthalate	--	--	--	--	--	NA	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	--	--	--	--	--	NA	--	--	--	--
			Naphthalene	--	--	--	--	--	Nasal	--	0.0001	--	0.0001
			Phenanthrene	--	--	--	--	--	NA	--	--	--	--
			Fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Pyrene	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	--	--	--	--	NA	--	--	--	--
			Chrysene	--	--	--	--	--	NA	--	--	--	--
			Benzo(b)fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Benzo(k)fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)pyrene	--	--	--	--	--	NA	--	--	--	--
			Dibenzo(a,h)anthracene	--	--	--	--	--	NA	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	--	NA	--	--	--	--
			Chemical Total	--	5E-11	--	--	5E-11		--	0.0002	--	0.0002
		Exposure Point Total						5E-11					0.0002
	Exposure Medium Total							5E-11					0.0002
Medium Total								1E-08					0.04
Receptor Total							Receptor Risk Total	1E-08				Receptor HI Total	0.04

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TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Aluminum	--	--	--	--	--	CNS	0.2	--	0.0003	0.2
			Antimony	--	--	--	--	--	Blood	0.8	--	0.006	0.8
			Arsenic	1E-04	--	4E-08	--	1E-04	Skin, CVS	3	--	0.003	3
			Barium	--	--	--	--	--	Kidney	0.05	--	0.0007	0.05
			Beryllium	--	--	--	--	--	GS	0.05	--	0.007	0.05
			Chromium	--	--	--	--	--	Fetotoxicity, GS, Bone	0.2	--	0.02	0.2
			Cobalt	--	--	--	--	--	NA	--	--	--	--
			Copper	--	--	--	--	--	GS	0.03	--	0.00003	0.03
			Iron	--	--	--	--	--	GS	9	--	0.009	9
			Manganese	--	--	--	--	--	CNS	7	--	0.2	7
			Selenium	--	--	--	--	--	Skin	0.1	--	0.0001	0.1
			Silver	--	--	--	--	--	Skin	0.04	--	0.0006	0.04
			Zinc	--	--	--	--	--	Blood	0.03	--	0.00002	0.03
			Tetrachloroethene	2E-06	--	1E-07	--	2E-06	Liver	0.005	--	0.0009	0.006
			Dimethylphthalate	--	--	--	--	--	NA	--	--	--	--
			Diethylphthalate	--	--	--	--	--	Body Weight	0.002	--	0.00008	0.002
			Di-n-butylphthalate	--	--	--	--	--	Mortality	0.010	--	0.002	0.01
			Bis(2-Ethylhexyl)phthalate	2E-06	--	4E-07	--	3E-06	Liver	0.10	--	0.05	0.1
			Naphthalene	--	--	--	--	--	Body Weight	0.002	--	0.0004	0.002
			Phenanthrene	--	--	--	--	--	Kidney	--	--	--	--
			Fluoranthene	--	--	--	--	--	Liver	0.001	--	--	0.001
			Pyrene	--	--	--	--	--	Kidney	0.002	--	0.002	0.004
			Benzo(a)anthracene	8E-06	--	--	--	8E-06	NA	--	--	--	--
			Chrysene	1E-08	--	--	--	1E-08	NA	--	--	--	--
			Benzo(b)fluoranthene	1E-05	--	--	--	1E-05	NA	--	--	--	--
			Benzo(k)fluoranthene	6E-06	--	--	--	6E-06	NA	--	--	--	--
			Benzo(a)pyrene	2E-04	--	--	--	2E-04	NA	--	--	--	--
			Dibenzo(a,h)anthracene	2E-04	--	--	--	2E-04	NA	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	--	Kidney	--	--	--	--
			Chemical Total	5E-04	--	6E-07	--	5E-04		20	--	0.3	20
		Exposure Point Total						5E-04					20
	Exposure Medium Total							5E-04					20

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TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Aluminum	--	--	--	--	--	CNS	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	--	--	--	--	NA	--	--	--	--
			Barium	--	--	--	--	--	Fetotoxicity	--	--	--	--
			Beryllium	--	--	--	--	--	GS	--	--	--	--
			Chromium	--	--	--	--	--	Lungs	--	--	--	--
			Cobalt	--	--	--	--	--	NA	--	--	--	--
			Copper	--	--	--	--	--	NA	--	--	--	--
			Iron	--	--	--	--	--	NA	--	--	--	--
			Manganese	--	--	--	--	--	CNS	--	--	--	--
			Selenium	--	--	--	--	--	NA	--	--	--	--
			Silver	--	--	--	--	--	NA	--	--	--	--
			Zinc	--	--	--	--	--	NA	--	--	--	--
			Tetrachloroethene	--	2E-06	--	--	2E-06	Liver	--	0.005	--	0.005
			Dimethylphthalate	--	--	--	--	--	NA	--	--	--	--
			Diethylphthalate	--	--	--	--	--	NA	--	--	--	--
			Di-n-butylphthalate	--	--	--	--	--	NA	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	--	--	--	--	--	NA	--	--	--	--
			Naphthalene	--	--	--	--	--	Nasal	--	0.002	--	0.002
			Phenanthrene	--	--	--	--	--	NA	--	--	--	--
			Fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Pyrene	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	--	--	--	--	NA	--	--	--	--
			Chrysene	--	--	--	--	--	NA	--	--	--	--
			Benzo(b)fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Benzo(k)fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)pyrene	--	--	--	--	--	NA	--	--	--	--
			Dibenzo(a,h)anthracene	--	--	--	--	--	NA	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	--	NA	--	--	--	--
			Chemical Total	--	2E-06	--	--	2E-06		--	0.007	--	0.007
		Exposure Point Total						2E-06					0.007
	Exposure Medium Total							2E-06					0.007
Medium Total								2E-06					0.007
Receptor Total								5E-04					20
							Receptor Risk Total	5E-04				Receptor HI Total	20

Note:

Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

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TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Total Body Weight HI	0.005
Total CNS HI	7
Total CVS HI	3
Total GS HI	9
Total Kidney HI	0.05
Total Liver HI	0.2
Total Skin HI	3
Total Nasal HI	0.002
Total Bone HI	0.2
Total Fetotoxicity HI	0.2
Total Mortality HI	0.01

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TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Aluminum	--	--	--	--	--	CNS	0.2	--	0.0004	0.2
			Antimony	--	--	--	--	--	Blood	0.5	--	0.008	0.5
			Arsenic	1E-04	--	3E-07	--	1E-04	Skin, CVS	2	--	0.004	2
			Barium	--	--	--	--	--	Kidney	0.03	--	0.001	0.03
			Beryllium	--	--	--	--	--	GS	0.03	--	0.01	0.04
			Chromium	--	--	--	--	--	Fetotoxicity, GS, Bone	0.1	--	0.03	0.2
			Cobalt	--	--	--	--	--	NA	--	--	--	--
			Copper	--	--	--	--	--	GS	0.02	--	0.00004	0.02
			Iron	--	--	--	--	--	GS	6	--	0.01	6
			Manganese	--	--	--	--	--	CNS	4	--	0.3	5
			Selenium	--	--	--	--	--	Skin	0.07	--	0.0002	0.07
			Silver	--	--	--	--	--	Skin	0.02	--	0.0008	0.03
			Zinc	--	--	--	--	--	Blood	0.02	--	0.00003	0.02
			Tetrachloroethene	2E-06	--	1E-06	--	3E-06	Liver	0.003	--	0.001	0.005
			Dimethylphthalate	--	--	--	--	--	NA	--	--	--	--
			Diethylphthalate	--	--	--	--	--	Body Weight	0.002	--	0.0001	0.002
			Di-n-butylphthalate	--	--	--	--	--	Mortality	0.007	--	0.003	0.01
			Bis(2-Ethylhexyl)phthalate	2E-06	--	3E-06	--	5E-06	Liver	0.07	--	0.07	0.1
			Naphthalene	--	--	--	--	--	Body Weight	0.001	--	0.0005	0.002
			Phenanthrene	--	--	--	--	--	Kidney	--	--	--	--
			Fluoranthene	--	--	--	--	--	Liver	0.0010	--	--	0.0010
			Pyrene	--	--	--	--	--	Kidney	0.001	--	0.003	0.004
			Benzo(a)anthracene	3E-06	--	--	--	3E-06	NA	--	--	--	--
			Chrysene	1E-08	--	--	--	1E-08	NA	--	--	--	--
			Benzo(b)fluoranthene	5E-06	--	--	--	5E-06	NA	--	--	--	--
			Benzo(k)fluoranthene	2E-06	--	--	--	2E-06	NA	--	--	--	--
			Benzo(a)pyrene	7E-05	--	--	--	7E-05	NA	--	--	--	--
			Dibenzo(a,h)anthracene	6E-05	--	--	--	6E-05	NA	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	--	Kidney	--	--	--	--
			Chemical Total	2E-04	--	4E-06	--	3E-04		13	--	0.4	14
		Exposure Point Total						3E-04					14
	Exposure Medium Total							3E-04					14

TABLE 9.3.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Aluminum	--	--	--	--	--	CNS	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	--	--	--	--	NA	--	--	--	--
			Barium	--	--	--	--	--	Fetotoxicity	--	--	--	--
			Beryllium	--	--	--	--	--	GS	--	--	--	--
			Chromium	--	--	--	--	--	Lungs	--	--	--	--
			Cobalt	--	--	--	--	--	NA	--	--	--	--
			Copper	--	--	--	--	--	NA	--	--	--	--
			Iron	--	--	--	--	--	NA	--	--	--	--
			Manganese	--	--	--	--	--	CNS	--	--	--	--
			Selenium	--	--	--	--	--	NA	--	--	--	--
			Silver	--	--	--	--	--	NA	--	--	--	--
			Zinc	--	--	--	--	--	NA	--	--	--	--
			Tetrachloroethene	--	2E-06	--	--	2E-06	Liver	--	0.003	--	0.003
			Dimethylphthalate	--	--	--	--	--	NA	--	--	--	--
			Diethylphthalate	--	--	--	--	--	NA	--	--	--	--
			Di-n-butylphthalate	--	--	--	--	--	NA	--	--	--	--
			Bis(2-Ethylhexyl)phthalate	--	--	--	--	--	NA	--	--	--	--
			Naphthalene	--	--	--	--	--	Nasal	--	0.001	--	0.001
			Phenanthrene	--	--	--	--	--	NA	--	--	--	--
			Fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Pyrene	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	--	--	--	--	NA	--	--	--	--
			Chrysene	--	--	--	--	--	NA	--	--	--	--
			Benzo(b)fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Benzo(k)fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)pyrene	--	--	--	--	--	NA	--	--	--	--
			Dibenzo(a,h)anthracene	--	--	--	--	--	NA	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	--	NA	--	--	--	--
			Chemical Total	--	2E-06	--	--	2E-06		--	0.005	--	0.005
		Exposure Point Total						2E-06					0.005
	Exposure Medium Total							2E-06					0.005
Medium Total								3E-04					14
Receptor Total							Receptor Risk Total	3E-04				Receptor HI Total	14

Note:

Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Total Body Weight HI	0.003
Total CNS HI	5
Total CVS HI	2
Total GS HI	6
Total Kidney HI	0.04
Total Liver HI	0.1
Total Skin HI	2
Total Nasal HI	0.001
Total Bone HI	0.2
Total Fetotoxicity HI	0.2
Total Mortality HI	0.01

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TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Aluminum	--	--	--	--	--					
			Antimony	--	--	--	--	--					
			Arsenic	2E-04	--	3E-07	--	2E-04					
			Barium	--	--	--	--	--					
			Beryllium	--	--	--	--	--					
			Chromium	--	--	--	--	--					
			Cobalt	--	--	--	--	--					
			Copper	--	--	--	--	--					
			Iron	--	--	--	--	--					
			Manganese	--	--	--	--	--					
			Selenium	--	--	--	--	--					
			Silver	--	--	--	--	--					
			Zinc	--	--	--	--	--					
			Tetrachloroethene	4E-06	--	1E-06	--	5E-06					
			Dimethylphthalate	--	--	--	--	--					
			Diethylphthalate	--	--	--	--	--					
			Di-n-butylphthalate	--	--	--	--	--					
			Bis(2-Ethylhexyl)phthalate	4E-06	--	3E-06	--	8E-06					
			Naphthalene	--	--	--	--	--					
			Phenanthrene	--	--	--	--	--					
			Fluoranthene	--	--	--	--	--					
			Pyrene	--	--	--	--	--					
			Benzo(a)anthracene	1E-05	--	--	--	1E-05					
			Chrysene	2E-08	--	--	--	2E-08					
			Benzo(b)fluoranthene	2E-05	--	--	--	2E-05					
			Benzo(k)fluoranthene	9E-06	--	--	--	9E-06					
			Benzo(a)pyrene	3E-04	--	--	--	3E-04					
			Dibenzo(a,h)anthracene	2E-04	--	--	--	2E-04					
			Benzo(g,h,i)perylene	--	--	--	--	--					
			Chemical Total	8E-04	--	5E-06	--	8E-04					
		Exposure Point Total						8E-04					
	Exposure Medium Total							8E-04					

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES - STORM SEWER REHABILITATION SAMPLING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Aluminum	--	--	--	--	--					
			Antimony	--	--	--	--	--					
			Arsenic	--	--	--	--	--					
			Barium	--	--	--	--	--					
			Beryllium	--	--	--	--	--					
			Chromium	--	--	--	--	--					
			Cobalt	--	--	--	--	--					
			Copper	--	--	--	--	--					
			Iron	--	--	--	--	--					
			Manganese	--	--	--	--	--					
			Selenium	--	--	--	--	--					
			Silver	--	--	--	--	--					
			Zinc	--	--	--	--	--					
			Tetrachloroethene	--	4E-06	--	--	4E-06					
			Dimethylphthalate	--	--	--	--	--					
			Diethylphthalate	--	--	--	--	--					
			Di-n-butylphthalate	--	--	--	--	--					
			Bis(2-Ethylhexyl)phthalate	--	--	--	--	--					
			Naphthalene	--	--	--	--	--					
			Phenanthrene	--	--	--	--	--					
			Fluoranthene	--	--	--	--	--					
			Pyrene	--	--	--	--	--					
			Benzo(a)anthracene	--	--	--	--	--					
			Chrysene	--	--	--	--	--					
			Benzo(b)fluoranthene	--	--	--	--	--					
			Benzo(k)fluoranthene	--	--	--	--	--					
			Benzo(a)pyrene	--	--	--	--	--					
			Dibenzo(a,h)anthracene	--	--	--	--	--					
			Benzo(g,h,i)perylene	--	--	--	--	--					
			Chemical Total	--	4E-06	--	--	4E-06					
		Exposure Point Total						4E-06					
	Exposure Medium Total							4E-06					
Medium Total								4E-06					
Receptor Total								8E-04					
							Receptor Risk Total	8E-04					

Note:

Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

ATTACHMENT A.4

TABLES FROM QUARTERLY UNDERDRAIN METERING PIT SAMPLING

TABLE 3-1

SUMMARY OF POSITIVE DETECTIONS FOR YEAR 1 MONITORING EVENTS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

PARAMETER	Surface Water Protection Criteria(1)	Residential Volatilization Criteria(2)	Stormwater Discharge Permit Criteria(3)	23MP01 S23GWMPM01 20070618 ORIGINAL	23MP01 FD-061807 20070618 DUPLICATE	23MP01 S23GWMPM02 20070906 ORIGINAL	23MP01 S23GWMPM-03 20071218 ORIGINAL	23MP01 FD-121807-01 20071218 DUPLICATE	23MP01 S23GWMPM-04 20080221 ORIGINAL
Volatile Organics (µg/L)									
BENZENE	710	130	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 J
BROMODICHLOROMETHANE	NE	NE	NA	0.3 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROFORM	14100	26	NA	3 J	2 J	0.5 U	0.5 U	0.5 U	0.5 U
CYCLOHEXANE	NE	NE	NA	0.5 U	0.5 U	0.1 J	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	NE	830	NA	0.3 J	0.2 J	0.3 J	0.2 J	0.5 U	0.2 J
ISOPROPYLBENZENE	NE	2800	NA	0.1 J	0.09 J	0.1 J	0.5 U	0.5 UJ	0.5 U
METHYL TERT-BUTYL ETHER	NE	21000	NA	1	0.9	0.4 J	0.6	0.6	0.7
TETRACHLOROETHENE	88	340	NA	0.3 J	0.3 J	0.4 J	0.3 J	0.2 J	0.3 J
TRICHLOROETHENE	2340	27	NA	0.4 J	0.3 J	0.5 J	0.4 J	0.3 J	0.4 J
PAHs (µg/L)									
1-METHYLNAPHTHALENE	NE	NE	NA	0.2 U	0.2 U	0.2 U	0.96 J	0.048 J	0.21 U
2-METHYLNAPHTHALENE	NE	NE	NA	0.17 J	0.16 J	0.2 U	1.1 J	0.2 UJ	0.21 UJ
4-NITROANILINE	NE	NE	NA	0.2 U	0.2 U	1 UJ	0.75 J	1.0 UR	1.0 UJ
ACENAPHTHENE	NE	NE	NA	0.2 U	0.2 U	0.2 U	0.83 J	0.029 J	0.21 U
ACENAPHTHYLENE	0.3	NE	NA	0.2 U	0.2 U	0.2 U	0.90 J	0.20 UJ	0.21 U
ANTHRACENE	1,100,000	NE	NA	0.2 U	0.2 U	0.2 U	0.92 J	0.20 UJ	0.21 U
BENZO(A)ANTHRACENE	0.3	NE	NA	0.07 U	0.07 U	0.041 U	1.0 J	0.042 UJ	0.045 U
BENZO(A)PYRENE	0.3	NE	NA	0.2 UJ	0.2 U	0.2 U	0.35 J	0.20 U	0.21 U
BENZO(B)FLUORANTHENE	0.3	NE	NA	0.08 U	0.08 U	0.075 U	0.64 J	0.078 UJ	0.082 U
BENZO(G,H,I)PERYLENE	NE	NE	NA	0.2 UJ	0.2 U	0.2 U	0.31	0.20 U	0.21 U
BENZO(K)FLUORANTHENE	0.3	NE	NA	0.2 UJ	0.2 UJ	0.2 U	0.53 J	0.20 U	0.21 U
CHRYSENE	NE	NE	NA	0.2 U	0.2 U	0.2 U	0.76 J	0.20 UJ	0.21 U
DIBENZO(A,H)ANTHRACENE	NE	NE	NA	0.2 UJ	0.2 U	0.2 U	0.14 J	0.20 U	0.21 U
FLUORANTHENE	3,700	NE	NA	0.2 U	0.2 U	0.2 U	1.1 J	0.20 UJ	0.21 U
FLUORENE	140,000	NE	NA	0.2 U	0.2 U	0.2 U	0.97 J	0.20 UJ	0.21 UJ
HEXACHLOROBENZENE	0.077	NE	NA	1 U	1 U	0.2 U	1.2 J	0.20 UJ	0.21 U
HEXACHLOROBUTADIENE	NE	NE	NA	0.2 U	0.2 U	0.48 U	0.64 J	0.099 U	0.21 U
INDENO(1,2,3-CD)PYRENE	NE	NE	NA	0.2 UJ	0.2 U	0.2 U	0.22	0.20 U	0.21 UJ
NAPHTHALENE	NE	NE	NA	0.2 U	0.2 U	0.2 U	1.0 J	0.088 J	0.21 U
PHENANTHRENE	0.3	NE	NA	0.2 U	0.2 U	0.2 U	0.98 J	0.20 UJ	0.21 U
PYRENE	110,000	NE	NA	0.2 U	0.2 U	0.2 U	0.84 J	0.20 UJ	0.21 U
PAHs, Filtered (µg/L)									
1-METHYLNAPHTHALENE	NE	NE	NA	NA	NA	NA	NA	NA	0.093 J
2-METHYLNAPHTHALENE	NE	NE	NA	NA	NA	NA	NA	NA	0.2 UJ
4-NITROANILINE	NE	NE	NA	NA	NA	NA	NA	NA	1.0 UJ
ACENAPHTHENE	NE	NE	NA	NA	NA	NA	NA	NA	0.031 J
ACENAPHTHYLENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.2 U
ANTHRACENE	1,100,000	NE	NA	NA	NA	NA	NA	NA	0.2 U
BENZO(A)ANTHRACENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.042 U

TABLE 3-1

SUMMARY OF POSITIVE DETECTIONS FOR YEAR 1 MONITORING EVENTS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

PARAMETER	Surface Water Protection Criteria[1]	Residential Volatilization Criteria[2]	Stormwater Discharge Permit Criteria[3]	23MP01 S23GWMPM01 20070618 ORIGINAL	23MP01 FD-061807 20070618 DUPLICATE	23MP01 S23GWMPM02 20070906 ORIGINAL	23MP01 S23GWMPM-03 20071218 ORIGINAL	23MP01 FD-121807-01 20071218 DUPLICATE	23MP01 S23GWMPM-04 20080221 ORIGINAL
PAHs, Filtered (continued) (µg/L)									
BENZO(A)PYRENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.2 U
BENZO(B)FLUORANTHENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.078 U
BENZO(G,H,I)PERYLENE	NE	NE	NA	NA	NA	NA	NA	NA	0.13 J
BENZO(K)FLUORANTHENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.2 U
CHRYSENE	NE	NE	NA	NA	NA	NA	NA	NA	0.2 U
DIBENZO(A,H)ANTHRACENE	NE	NE	NA	NA	NA	NA	NA	NA	0.2 U
FLUORANTHENE	3,700	NE	NA	NA	NA	NA	NA	NA	0.2 U
FLUORENE	140,000	NE	NA	NA	NA	NA	NA	NA	0.2 UJ
HEXACHLOROBENZENE	0.077	NE	NA	NA	NA	NA	NA	NA	0.2 U
HEXACHLOROBUTADIENE	NE	NE	NA	NA	NA	NA	NA	NA	0.2 U
INDENO(1,2,3-CD)PYRENE	NE	NE	NA	NA	NA	NA	NA	NA	0.22 J
NAPHTHALENE	NE	NE	NA	NA	NA	NA	NA	NA	0.069 J
PHENANTHRENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.2 U
PYRENE	110,000	NE	NA	NA	NA	NA	NA	NA	0.2 U
Inorganics, Total (µg/L)									
ALUMINUM	NE	NA	NA	473	115	322	38.1	21.8	29.4
ARSENIC	4	NA	NA	3.7 U	3 U	13.9	2.2 U	4.7 U	3.1
BARIUM	NE	NA	NA	48.2	52.4	87	55.2	53.4	55.9
CALCIUM	NUT	NA	NA	33800	35800	32000	35,500	34,700	34,300
CHROMIUM	110 [4]	NA	NA	0.94 U	0.81 U	2	0.41	0.28 U	0.38 U
COBALT	NE	NA	NA	0.84 U	0.64 U	0.26 U	0.66	0.53	0.6
COPPER	48	NA	60	3 U	3 U	4.2	0.44 U	0.22 U	0.8 U
IRON	NUT	NA	NA	9,190	11,900	70,800	9,860	10,200	4,380
LEAD	13	NA	30	2.2	9.3	8.4	2.5 U	2.2 U	1.4 U
MAGNESIUM	NUT	NA	NA	7,260	7660	7,020	7,660	7,490	7,450
MANGANESE	NE	NA	NA	661	715	845	858	815	784
NICKEL	880	NA	NA	1.1 U	0.88 U	0.41 U	0.53	0.46	0.64
POTASSIUM	NUT	NA	NA	5210	5490	5,270	5,590	5,490	5,150
SELENIUM	50	NA	NA	1.5 U	2 J	1.5 U	1.5 U	1.5 U	2.2 U
SILVER	12	NA	NA	0.46 U	0.46 U	1.5	0.46 U	0.46 U	0.54 U
SODIUM	NUT	NA	NA	46,900	49,600	52,100	53,400	52,300	50,100
VANADIUM	NE	NA	NA	1.3 U	1.4 U	3.7	0.34 U	0.29 U	0.52 U
ZINC	123	NA	200	21.3 J	22.3	47.1	22.8	20.0	26.6
Inorganics, Filtered (µg/L)									
ALUMINUM	NE	NA	NA	20.4 J	36.7 J	21.3 J	19.0 U	19.0 U	35.4
ARSENIC	4	NA	NA	3.5 U	2.2 U	1.2 J	1.9 U	1.1 U	2.8
BARIUM	NE	NA	NA	44.6	46.4	50.1	48.9	49.6	56.8
CALCIUM	NUT	NA	NA	33,600	34,700	31,400	33,100	33,400	36,000
CHROMIUM	110 [4]	NA	NA	1.2 U	0.44 U	0.3 J	0.29	0.48	0.38 U
COBALT	NE	NA	NA	0.67 U	0.86 U	0.47 J	0.48	0.51	0.64
IRON	NUT	NA	NA	3,470	3,630	3,600	4,190	4,140	3,750

TABLE 3-1

SUMMARY OF POSITIVE DETECTIONS FOR YEAR 1 MONITORING EVENTS
SITE 23 UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

PARAMETER	Surface Water Protection Criteria[1]	Residential Volatilization Criteria[2]	Stormwater Discharge Permit Criteria[3]	23MP01 S23GWMPM01 20070618 ORIGINAL	23MP01 FD-061807 20070618 DUPLICATE	23MP01 S23GWMPM02 20070906 ORIGINAL	23MP01 S23GWMPM-03 20071218 ORIGINAL	23MP01 FD-121807-01 20071218 DUPLICATE	23MP01 S23GWMPM-04 20080221 ORIGINAL
Inorganics, Filtered (continued) (µg/L)									
LEAD	13	NA	30	1.3 J	1.8 J	1.1 U	2.1 U	2.8 U	1.4 U
MAGNESIUM	NUT	NA	NA	7,200	7,480	6,980	7,250	7,300	8,020
MANGANESE	NE	NA	NA	645	664	708	764	770	815
NICKEL	880	NA	NA	1.1 U	0.88 U	0.78 J	1.0	0.64	0.66
POTASSIUM	NUT	NA	NA	5,090	5,390	5,320	5,360	5,390	5,390
SELENIUM	50	NA	NA	1.5 U	1.7 J	2.4 U	1.5 U	2.3 U	2.2 U
SODIUM	NUT	NA	NA	46,600	48,400	52,600	50,400	51,400	52,100
ZINC	123	NA	200	21.4 J	19.5 J	15	18.6	20.8	26
Petroleum Hydrocarbons (µg/L)									
ETPH (C09-C36)	NE	NE	2500[5]	55 J	79 U	140 J	160 U	1600 J	75 U
Petroleum Hydrocarbons, Filtered (µg/L)									
ETPH (C09-C36)	NE	NE	2500[5]	NA	NA	NA	NA	NA	75 U

1 Connecticut Remediation Standard Regulations (January 1996) and Comprehensive List of Approved Additional Polluting Substances Criteria and Alternative Criteria (October 2005).
2 Proposed Revisions to Connecticut's Remediation Standard Regulations, Volatilization Criteria (March 2003).
3 NSB-NLON General Permit for the Discharge of Stormwater Associated with Industrial Activity (DEP-PERD-GP-014, Issuance Date: October 1, 2002 and Modified Date: July 15, 2003).
4 Criteria is for hexavalent chromium
5 Criteria is for oil and grease.
BOLD Sample results that exceed a criterion are shown in bold font.
NA Not Applicable
NE Not Established
NUT Essential Nutrient

ATTACHMENT A.5

RISKS BASED ON QUARTERLY UNDERDRAIN METERING PIT SAMPING RESULTS

TABLE 2.1
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SITE 23 - UNDERDRAIN METERING PIT SAMPLING
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe:
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[2]	Concentration Used for Screening[3]	Background Concentrations[4]	Screening Toxicity Value[5]	Potential ARAR/TBC	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
Site 23	Volatile Organic Compounds														
	71-43-2	Benzene	0.2 J	0.2 J	ug/L	S23GWMPM04	1/4	0.5 - 0.5	0.2	NA	0.35 C	1 5 5	CTDEP RSR FED-MCL CTDEP-MCL	No	BSL
	75-27-4	Bromodichloromethane	0.3 J	0.3 J	ug/L	S23GWMPM01	1/4	0.5 - 0.5	0.3	NA	0.18 C	0.56 80 80	CTDEP RSR FED-MCL CTDEP-MCL	Yes	ASL
	67-66-3	Chloroform	2 J	3 J	ug/L	S23GWMPM01	1/4	0.5 - 0.5	3	NA	0.17 C	6 80 80	CTDEP RSR FED-MCL CTDEP-MCL	Yes	ASL
	156-59-2	cis-1,2-Dichloroethene	0.2 J	0.3 J	ug/L	S23GWMPM01 S23GWMPM02	4/4	0.5 - 0.5	0.3	NA	6.1 N	70 70 70	CTDEP RSR FED-MCL CTDEP-MCL	No	BSL
	110-82-7	Cyclohexane	0.1 J	0.1 J	ug/L	S23GWMPM02	1/4	0.5 - 0.5	0.1	NA	1000 N	NA NA NA	NA NA NA	No	NTX
	98-82-8	Isopropylbenzene	0.09 J	0.1 J	ug/L	S23GWMPM01 S23GWMPM02	2/4	0.5 - 0.5	0.1	NA	66 N	30 NA NA	CTDEP RSR NA NA	No	BSL
	1634-04-4	Methyl Tert-Butyl Ether	0.4 J	1	ug/L	S23GWMPM01	4/4	-	1	NA	11 C	70 NA NA	CTDEP RSR NA NA	No	BSL
	127-18-4	Tetrachloroethene	0.2 J	0.4 J	ug/L	S23GWMPM02	4/4	-	0.4	NA	0.1 C	5 5 5	CTDEP RSR FED-MCL CTDEP-MCL	Yes	ASL
	79-01-6	Trichloroethene	0.3 J	0.5 J	ug/L	S23GWMPM02	4/4	-	0.5	NA	0.028 C	5 5 5	CTDEP RSR FED-MCL CTDEP-MCL	Yes	ASL
	PAHs														
		1-Methylnaphthalene	0.048 J	0.96 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.96	NA	0.62 N[7]	49 NA NA	CTDEP RSR NA NA	Yes	ASL
	91-57-6	2-Methylnaphthalene	0.16 J	1.1 J	ug/L	S23GWMPM-03	2/4	0.2 - 0.21	1.1	NA	0.62 N[7]	49 NA NA	CTDEP RSR NA NA	Yes	ASL
	100-01-6	4-Nitroaniline	0.75 J	0.75 J	ug/L	S23GWMPM-03	1/4	0.2 - 1	0.75	NA	3.2 C	21 NA NA	CTDEP RSR NA NA	No	BSL
	83-32-9	Acenaphthene	0.029 J	0.83 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.83	NA	37 N	NA NA NA	NA NA NA	No	BSL
	208-96-8	Acenaphthylene	0.9 J	0.9 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.9	NA	37 N[8]	420 NA NA	CTDEP RSR NA NA	No	BSL
	120-12-7	Anthracene	0.92 J	0.92 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.92	NA	180 N	2000 NA NA	CTDEP RSR NA NA	No	BSL
	56-55-3	Benzo(a)anthracene	1 J	1 J	ug/L	S23GWMPM-03	1/4	0.041 - 0.07	1	NA	0.092 C	0.06 NA NA	CTDEP RSR NA NA	Yes	ASL
	50-32-8	Benzo(a)pyrene	0.35 J	0.35 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.35	NA	0.0092 C	0.2 0.2 0.2	CTDEP RSR FED-MCL CTDEP-MCL	Yes	ASL
	205-99-2	Benzo(b)fluoranthene	0.64 J	0.64 J	ug/L	S23GWMPM-03	1/4	0.075 - 0.082	0.64	NA	0.092 C	0.08 NA NA	CTDEP RSR NA NA	Yes	ASL
	191-24-2	Benzo(g,h,i)perylene	0.31	0.31	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.31	NA	18 N[9]	NA NA NA	NA NA NA	No	BSL
	207-08-9	Benzo(k)fluoranthene	0.53 J	0.53 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.53	NA	0.92 C	0.5 NA NA	CTDEP RSR NA NA	Yes	ASL

TABLE 2.1
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SITE 23 - UNDERDRAIN METERING PIT SAMPLING
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe:
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[2]	Concentration Used for Screening[3]	Background Concentrations[4]	Screening Toxicity Value[5]	Potential ARAR/TBC	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
	218-01-9	Chrysene	0.76 J	0.76 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.76	NA	9.2 C	4.8 NA NA	CTDEP RSR NA NA	No	BSL
	53-70-3	Dibenzo(a,h)anthracene	0.14 J	0.14 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.14	NA	0.0029 C	0.2 NA NA	CTDEP RSR NA NA	Yes	ASL
	206-44-0	Fluoranthene	1.1 J	1.1 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	1.1	NA	150 N	280 NA NA	CTDEP RSR NA NA	No	BSL
	86-73-7	Fluorene	0.97 J	0.97 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.97	NA	24 N	280 NA NA	CTDEP RSR NA NA	No	BSL
	118-74-1	Hexachlorobenzene	1.2 J	1.2 J	ug/L	S23GWMPM-03	1/4	0.2 - 1	1.2	NA	0.042 C	1 1 1	CTDEP RSR FED-MCL CTDEP-MCL	Yes	ASL
	87-68-3	Hexachlorobutadiene	0.64 J	0.64 J	ug/L	S23GWMPM-03	1/4	0.099 - 0.48	0.64	NA	0.86 C	49 NA 50	CTDEP RSR NA CTDEP-MCL	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.22	0.22	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.22	NA	0.092 C	0.5 NA NA	CTDEP RSR NA NA	Yes	ASL
	91-20-3	Naphthalene	0.088 J	1 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	1	NA	0.62 N	280 NA NA	CTDEP RSR NA NA	Yes	ASL
	85-01-8	Phenanthrene	0.98 J	0.98 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.98	NA	18 N[9]	200 NA NA	CTDEP RSR NA NA	No	BSL
	129-00-0	Pyrene	0.84 J	0.84 J	ug/L	S23GWMPM-03	1/4	0.2 - 0.21	0.84	NA	18 N	200 NA NA	CTDEP RSR NA NA	No	BSL
	PAHs, Filtered														
		1-Methylnaphthalene	0.093 J	0.093 J	ug/L	S23GWMPM04	1/1	-	0.093	NA	0.62 N[7]	49[10] NA NA	CTDEP RSR NA NA	No	BSL
	83-32-9	Acenaphthene	0.031 J	0.031 J	ug/L	S23GWMPM04	1/1	-	0.031	NA	37 N	NA NA NA	NA NA NA	No	BSL
	191-24-2	Benzo(g,h,i)perylene	0.13 J	0.13 J	ug/L	S23GWMPM04	1/1	-	0.13	NA	18 N[9]	NA NA NA	NA NA NA	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.22 J	0.22 J	ug/L	S23GWMPM04	1/1	-	0.22	NA	0.092 C	0.5 NA NA	CTDEP RSR NA NA	Yes	ASL
	91-20-3	Naphthalene	0.069 J	0.069 J	ug/L	S23GWMPM04	1/1	-	0.069	NA	0.62 N	280 NA NA	CTDEP RSR NA NA	No	BSL
	Inorganics														
	7429-90-5	Aluminum	21.8	473	ug/L	S23GWMPM01	4/4	-	473	3560	3600 N	NA 50 NA	NA FED-SMCL NA	Yes	ASL
	7440-38-2	Arsenic	3.1	13.9	ug/L	S23GWMPM02	2/4	2.2 - 4.7	13.9	1.92	0.045 C	50 10 10	CTDEP RSR FED-MCL CTDEP-MCL	Yes	ASL
	7440-39-3	Barium	48.2	87	ug/L	S23GWMPM02	4/4	-	87	227	260 N	1000 2000 2000	CTDEP RSR FED-MCL CTDEP-MCL	No	BSL
	7440-70-2	Calcium	32000	35800	ug/L	S23GWMPM01-D	4/4	-	35800	188000	NA	NA NA NA	NA NA NA	No	NUT
	15723-28-1	Chromium	0.41	2	ug/L	S23GWMPM02	2/4	0.28 - 0.94	2	49.9	11 N[11]	50 100 100	CTDEP RSR FED-MCL CTDEP-MCL	No	BSL

TABLE 2.1
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SITE 23 - UNDERDRAIN METERING PIT SAMPLING
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe:
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[2]	Concentration Used for Screening[3]	Background Concentrations[4]	Screening Toxicity Value[5]	Potential ARAR/TBC	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
	7440-48-4	Cobalt	0.53	0.66	ug/L	S23GWMPM-03	2/4	0.26 - 0.84	0.66	48.6	73 N	NA NA NA	NA NA NA	No	BSL
	7440-50-8	Copper	4.2	4.2	ug/L	S23GWMPM02	1/4	0.22 - 3	4.2	107	150 N	1300 1300 1300	CTDEP RSR FED-MCL CTDEP-MCL	No	BSL
	7439-89-6	Iron	4380	70800	ug/L	S23GWMPM02	4/4	-	70800	28200	1100 N	NA 300 NA	CTDEP RSR FED-SMCL CTDEP-MCL	Yes	ASL
	7439-92-1	Lead	2.2	9.3	ug/L	S23GWMPM01-D	2/4	1.4 - 2.5	9.3	6.63	NA	15 15 15	CTDEP RSR FED-MCL CTDEP-MCL	No	BSL
	7439-95-4	Magnesium	7020	7660	ug/L	S23GWMPM01-D S23GWMPM-03	4/4	-	7660	191000	NA	NA NA NA	NA NA NA	No	NUT
	7439-96-5	Manganese	661	858	ug/L	S23GWMPM-03	4/4	-	858	11700	88 N	NA 50 NA	NA FED-SMCL NA	Yes	ASL
	7440-02-0	Nickel	0.46	0.64	ug/L	S23GWMPM04	2/4	0.41 - 1	0.64	32.2	73 N	100 NA 100	CTDEP RSR NA CTDEP-MCL	No	BSL
	7440-09-7	Potassium	5150	5590	ug/L	S23GWMPM-03	4/4	-	5590	70800	NA	NA NA NA	NA NA NA	No	NUT
	7782-49-2	Selenium	2 J	2 J	ug/L	S23GWMPM01-D	1/4	1.5 - 2.2	2	3.19	18 N	50 50 50	CTDEP RSR FED-MCL CTDEP-MCL	No	BSL
	7440-22-4	Silver	1.5	1.5	ug/L	S23GWMPM02	1/4	0.46 - 0.54	1.5	NA	18 N	36 100 50	NA FED-SMCL NA	No	BSL
	7440-23-5	Sodium	46900	53400	ug/L	S23GWMPM-03	4/4	-	53400	1900000	NA	NA NA NA	NA NA NA	No	NUT
	7440-62-2	Vanadium	3.7	3.7	ug/L	S23GWMPM02	1/4	0.29 - 1.4	3.7	10.2	3.6 N	50 NA NA	CTDEP RSR NA NA	Yes	ASL
	7440-66-6	Zinc	20 J	47.1	ug/L	S23GWMPM02	4/4	-	47.1	131	1100 N	5000 NA NA	CTDEP RSR NA NA	No	BSL
	Inorganics, Filtered														
	7429-90-5	Aluminum	20.4 J	36.7 J	ug/L	S23GWMPM01-D	3/4	19 - 19	36.7	64.4	3600 N	NA 50 NA	NA FED-SMCL NA	No	BSL
	7440-38-2	Arsenic	1.2 J	2.8	ug/L	S23GWMPM04	2/4	1.1 - 3.5	2.8	2.55	0.045 C	50 10 10	CTDEP RSR FED-MCL CTDEP-MCL	Yes	ASL
	7440-39-3	Barium	44.6	56.8	ug/L	S23GWMPM04	4/4	-	56.8	124	260 N	1000 2000 2000	CTDEP RSR FED-MCL CTDEP-MCL	No	BSL
	7440-70-2	Calcium	31400	36000	ug/L	S23GWMPM04	4/4	-	36000	152000	NA	NA NA NA	NA NA NA	No	NUT
	15723-28-1	Chromium	0.29 J	0.48	ug/L	S23GWMPM-03-D	2/4	0.38 - 1.2	0.48	16	11 N[11]	50 100 100	CTDEP RSR FED-MCL CTDEP-MCL	No	BSL
	7440-48-4	Cobalt	0.47 J	0.64	ug/L	S23GWMPM04	3/4	0.67 - 0.86	0.64	43.3	73 N	NA NA NA	NA NA NA	No	BSL
	7439-89-6	Iron	3470	4190	ug/L	S23GWMPM-03	4/4	-	4190	25300	1100 N	NA 300 NA	NA FED-SMCL NA	Yes	ASL

TABLE 2.1
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SITE 23 - UNDERDRAIN METERING PIT SAMPLING
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe:
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[2]	Concentration Used for Screening[3]	Background Concentrations[4]	Screening Toxicity Value[5]	Potential ARAR/TBC	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
	7439-92-1	Lead	1.3 J	1.8 J	ug/L	S23GWMPM01-D	1/4	1.1 - 2.8	1.8	2.52	NA	15 15 15	CTDEP RSR FED-MCL CTDEP-MCL	No	BSL
	7439-95-4	Magnesium	6980	8020	ug/L	S23GWMPM04	4/4	-	8020	150000	NA	NA NA NA	NA NA NA	No	NUT
	7439-96-5	Manganese	645	815	ug/L	S23GWMPM04	4/4	-	815	9400	88 N	NA 50 NA	NA FED-SMCL NA	Yes	ASL
	7440-02-0	Nickel	0.64 J	1	ug/L	S23GWMPM-03	3/4	0.88 - 1.1	1	15.3	73 N	100 NA 100	NA NA NA	No	BSL
	7440-09-7	Potassium	5090	5390	ug/L	S23GWMPM01-D S23GWMPM-03-D S23GWMPM04	4/4	-	5390	60000	NA	NA NA NA	NA NA NA	No	NUT
	7782-49-2	Selenium	1.7 J	1.7 J	ug/L	S23GWMPM01-D	1/4	1.5 - 2.4	1.7	NA	18 N	50 50 50	CTDEP RSR FED-MCL CTDEP-MCL	No	BSL
	7440-23-5	Sodium	46600	52600	ug/L	S23GWMPM02	4/4	-	52600	1580000	NA	NA NA NA	NA NA NA	No	NUT
	7440-66-6	Zinc	15 J	26	ug/L	S23GWMPM04	4/4	-	26	109	1100 N	5000 NA NA	CTDEP RSR NA NA	No	BSL
	Petroleum Hydrocarbons														
		Total Petroleum Hydrocarbons	55 J	1600 J	ug/L	S23GWMPM-03-D	3/4	75 - 160	1600	NA	NA	500 NA NA	CTDEP RSR NA NA	Yes	ASL

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - Values are from the Basewide Groundwater Operable Unit Remedial Investigation Report (Tetra Tech, January 2002).
5 - USEPA Region IX Preliminary Remediation Goal (PRG). The noncarcinogenic values (denoted with a "N" flag) are the PRG divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag) (USEPA Region IX, October 2004, Updated December 28, 2004).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
7 - Naphthalene is used as a surrogate for 1- and 2-methylnaphthalene.
8- Acenaphthene is used as a surrogate for acenaphthylene.
9 - Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
10 - 2-methylnaphthalene is used as a surrogate for 1-methylnaphthalene.
11 - Value is for hexavalent chromium.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
S23GWMPM01
S23GWMPM01-D
S23GWMPM02
S23GWMPM-03
S23GWMPM-03-D
S23GWMPM04

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirements To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
N = Noncarcinogen
NA = Not Applicable/Not Available
FED-MCL = Federal Maximum Contaminant Level (USEPA, 2006)
FED-SMCL = Federal Maximum Contaminant Level (USEPA, 2006)
CTDEP-RSR = Connecticut DEP Remediation Standard Regulations, 1996.
CTDEP-MCL = Connecticut DEP Maximum Contaminant Level.

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level/ARAR/TBC

For elimination as a COPC:
BSL = Below COPC Screening Level
NUT = Essential nutrient
NTX = No toxicity criteria
EPA1 = USEPA Region 1 does not advocate evaluation of this chemical

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Site 23	Bromodichloromethane	ug/L	0.26	(1)	0.3 J	0.3	ug/L	Maximum Detected Concentration	(2)
	Chloroform	ug/L	0.81	(1)	3 J	2.5	ug/L	Maximum Detected Concentration	(2,3)
	Tetrachloroethene	ug/L	0.31	(1)	0.4 J	0.4	ug/L	Maximum Detected Concentration	(2)
	Trichloroethene	ug/L	0.40	(1)	0.5 J	0.5	ug/L	Maximum Detected Concentration	(2)
	1-Methylnaphthalene	ug/L	0.20	(1)	0.96 J	0.492	ug/L	Maximum Detected Concentration	(2,3)
	2-Methylnaphthalene	ug/L	0.24	(1)	1.1 J	0.6	ug/L	Maximum Detected Concentration	(2,3)
	Benzo(a)anthracene	ug/L	0.15	(1)	1 J	0.51	ug/L	Maximum Detected Concentration	(2,3)
	Benzo(a)pyrene	ug/L	0.13	(1)	0.35 J	0.225	ug/L	Maximum Detected Concentration	(2,3)
	Benzo(b)fluoranthene	ug/L	0.11	(1)	0.64 J	0.3395	ug/L	Maximum Detected Concentration	(2,3)
	Benzo(k)fluoranthene	ug/L	0.16	(1)	0.53 J	0.315	ug/L	Maximum Detected Concentration	(2,3)
	Dibenzo(a,h)anthracene	ug/L	0.11	(1)	0.14 J	0.12	ug/L	Maximum Detected Concentration	(2,3)
	Hexachlorobenzene	ug/L	0.34	(1)	1.2 J	0.65	ug/L	Maximum Detected Concentration	(2,3)
	Indeno(1,2,3-cd)pyrene	ug/L	0.12	(1)	0.22	0.16	ug/L	Maximum Detected Concentration	(2,3)
	Naphthalene	ug/L	0.21	(1)	1 J	0.552	ug/L	Maximum Detected Concentration	(2,3)
	Aluminum	ug/L	169	(1)	473	322	ug/L	Maximum Detected Concentration	(2,3)
	Arsenic	ug/L	5.1	(1)	13.9	13.9	ug/L	Maximum Detected Concentration	(2)
	Iron	ug/L	23939	(1)	70800	70800	ug/L	Maximum Detected Concentration	(2)
	Manganese	ug/L	788	(1)	858	845	ug/L	Maximum Detected Concentration	(2,3)
	Vanadium	ug/L	1.2	(1)	3.7	3.7	ug/L	Maximum Detected Concentration	(2)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
J - Estimated value.
1 - There were an insuffcent number of samples to calculate distribution statistics.
2 - There were only four rounds of results which is insufficient to calculate a temporal average, therefore the maximum detected concentration is used as the exposure point concentration.

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Workers	Adult	Site 23	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	U.S. EPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	3300	cm2	U.S. EPA, 2004	
				EV	Event Frequency	1	events/day	(1)	DAevent x EV x EF x ED x SA
				ET	Exposure Time	4	hours/day	(1)	BW x AT
				EF	Exposure Frequency	30	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	See text for calculation of DAevent.
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	U.S. EPA, 1989	

Sources:

1 - Professional judgment.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = NA

Noncancer Ingestion Intake = NA

Cancer Dermal Intake = 5.54E-02

Noncancer Dermal Intake = 3.87E+00

TABLE 4.2.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	Site 23	CA	Chemical concentration in air	Calculated	mg/m3	VDEQ, 2004	Intake (mg/kg/day) =
				CW	Chemical concentration in water.	Average	ug/L		
				CF	Conversion Factor	0.001	mg/ug	--	CA x IR x ET x EF x ED
				IR	Inhalation Rate	2.5	m3/hour	U.S. EPA, 1993	BW x AT
				ET	Exposure Time	4	hours/day	(1)	
				EF	Exposure Frequency	30	days/year	(1)	CA = CW x CF x VF
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	U.S. EPA, 1989	
				VF	Volatilization Factor	Calculated	(mg/m3)/(mg/L)	VDEQ, 2004	

Notes:

1 - Professional judgment.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

VDEQ, 2004: Virginia Department of Environmental Quality (VDEQ, online- http://www.deq.state.va.us/vrprisk/homepage.html).

Unit Intake Calculations

Inhalation Intake = (IR x ET x EF x ED)/(BW x AT)

Cancer Inhalation Intake = 1.68E-04 Noncancer Inhalation Intake = 1.17E-02

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Child	Site 23	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	U.S. EPA, 2002a	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	1.5	L/day	U.S. EPA, 1994	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	U.S. EPA, 1994	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	U.S. EPA, 1989	
				ED2	Exposure Duration (Age 2 - 6)	4	years	U.S. EPA, 1989	
				BW	Body Weight	15	kg	U.S. EPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2190	days	U.S. EPA, 1989	
Dermal	Residents	Child	Site 23	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	U.S. EPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	6,600	cm2	U.S. EPA, 2004	
				EV	Event Frequency	1	events/day	U.S. EPA, 2004	DAevent x EV x EF x ED x SA
				ET	Exposure Time	0.25	hours/day	U.S. EPA, 1997	BW x AT
				EF	Exposure Frequency	350	days/year	U.S. EPA, 1994	
				ED1	Exposure Duration (Age 0 - 2)	2	years	U.S. EPA, 1989	See text for calculation of DAevent.
				ED2	Exposure Duration (Age 2 - 6)	4	years	U.S. EPA, 1989	
				BW	Body Weight	15	kg	U.S. EPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2190	days	U.S. EPA, 1989	

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

U.S. EPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

U.S. EPA, 1994: U.S. EPA Region I Risk Updates, August 1994.

U.S. EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa

U.S. EPA, 2002:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake (Age 0 - 2) = 2.74E-06

Cancer Ingestion Intake (Age 2 - 6) = 5.48E-06

Cancer Dermal Intake (Age 0 - 2) = 1.21E+01

Cancer Dermal Intake (Age 2 - 6) = 2.41E+01

Noncancer Ingestion Intake = 9.59E-05

Noncancer Dermal Intake = 4.22E+02

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	Site 23	CGW	Chemical Concentration in Groundwater	95% UCL or Max	ug/L	U.S. EPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	2	L/day	U.S. EPA, 1994	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	U.S. EPA, 1994	BW x AT
				ED1	Exposure Duration (Age 10 - 16)	10	years	U.S. EPA, 1989	
				ED2	Exposure Duration (Age 16 - 30)	14	years	U.S. EPA, 1989	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	U.S. EPA, 1989	
Dermal	Residents	Adult	Site 23	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	U.S. EPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				SA	Skin Surface Available for Contact	18,000	cm2	U.S. EPA, 2004	
				EV	Event Frequency	1	events/day	U.S. EPA, 2004	DAevent x EV x EF x ED x SA
				ET	Exposure Time	0.25	hours/day	U.S. EPA, 2004	BW x AT
				EF	Exposure Frequency	350	days/year	U.S. EPA, 1994	
				ED1	Exposure Duration (Age 10 - 16)	10	years	U.S. EPA, 1989	See text for calculation of DAevent.
				ED2	Exposure Duration (Age 16 - 30)	14	years	U.S. EPA, 1989	
				BW	Body Weight	70	kg	U.S. EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	U.S. EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	U.S. EPA, 1989	

Sources:

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

U.S. EPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

U.S. EPA, 1994: U.S. EPA Region I Risk Updates, August 1994.

U.S. EPA, 1997: Exposure Factors Handbook. U.S. EPA/600/8-95/002FA.

U.S. EPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake Age 10 - 16) = 3.91E-06

Cancer Ingestion Intake Age 16 - 30) = 5.48E-06

Cancer Dermal Intake Age 10 - 16) = 3.52E+01

Cancer Dermal Intake (Age 16 - 30) = 4.93E+01

Noncancer Ingestion Intake = 6.58E-05

Noncancer Dermal Intake = 5.92E+02

TABLE 4.5
INTERMEDIATE VARIABLES FOR CALCULATING DA(EVENT)
SITE 23 - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Chemical of Potential Concern	Media	Dermal Absorption Fraction (soil)	FA	Kp		T(event)		Tau		T*		B
			Value	Value	Units	Value	Units	Value	Units	Value	Units	Value
Volatile Organic Compounds												
Bromodichloromethane	Groundwater	NA	1	4.6E-03	cm/hr	(1)	hr	8.8E-01	hr	2.1E+00	hr	2.3E-02
Chloroform	Groundwater	NA	1	6.8E-03	cm/hr	(1)	hr	5.0E-01	hr	1.2E+00	hr	2.9E-02
Tetrachloroethene	Groundwater	NA	1	3.3E-02	cm/hr	(1)	hr	9.1E-01	hr	2.2E+00	hr	1.7E-01
Trichloroethene	Groundwater	NA	1	1.2E-02	cm/hr	(1)	hr	5.8E-01	hr	1.4E+00	hr	5.1E-02
Semivolatile Organic Compounds												
1-Methylnaphthalene	Groundwater	NA	1	9.1E-02	cm/hr	(1)	hr	6.6E-01	hr	1.6E+00	hr	4.2E-01
2-Methylnaphthalene	Groundwater	NA	1	8.9E-02	cm/hr	(1)	hr	6.6E-01	hr	1.6E+00	hr	4.1E-01
Benzo(a)anthracene(2)	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene(2)	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene(2)	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene(2)	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene(2)	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	Groundwater	NA	0.9	1.3E-01	cm/hr	(1)	hr	4.2E+00	hr	1.6E+01	hr	8.7E-01
Indeno(1,2,3-cd)pyrene(2)	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Groundwater	NA	1	4.7E-02	cm/hr	(1)	hr	5.6E-01	hr	1.3E+00	hr	2.0E-01
Inorganics												
Aluminum	Groundwater	NA	1	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Arsenic	Groundwater	NA	1	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Iron	Groundwater	NA	1	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Manganese	Groundwater	NA	1	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Vanadium	Groundwater	NA	1	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA

Notes:
All values from EPA's Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, July 2004.
1 - T_{event} is 4 hours for the construction worker and 0.25 hours for the child and adult resident.
2 - RAGS Part E recommends that dermal exposures to PAHs in water should not be quantitatively evaluated in the risk assessment.
FA = Fraction Absorbed Water
Kp = Dermal Permeability Coefficient of Compound in Water
T(event) = Event Duration
Tau = Lag Time
T* = Time to Reach Steady-State
B = Dimensionless Ratio of the Permeability Coefficient of a Compound Through the Stratum Corneum Relative to its Permeability Coefficient Across the Viable Epidermis
NA = Not applicable.

TABLE 5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 23 - UNDERDRAIN METERING PIT SAMPLING
NSB-NLON, GROTON, CONNECTICUT

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds										
Bromodichloromethane	Chronic	2.0E-01	mg/kg/day	1	2.0E-01	mg/kg/day	Kidney	1000/1	IRS	4/24/2008
Chloroform	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	100/1	IRS	4/24/2008
Tetrachloroethene	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	1000/1	IRS	4/24/2008
Trichloroethene	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Liver, Kidney	NA	USEPA(1)	8/2001
Semivolatile Organic Compounds										
1-Methylnaphthalene[3]	Chronic	4.0E-03	mg/kg/day	1	4.0E-03	mg/kg/day	Lungs	1000/1	IRS	4/24/2008
2-Methylnaphthalene	Chronic	4.0E-03	mg/kg/day	1	4.0E-03	mg/kg/day	Lungs	1000/1	IRS	4/24/2008
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	Chronic	8.0E-04	mg/kg/day	1	8.0E-04	mg/kg/day	Liver	100/1		
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Body Weight	3000/1	IRS	4/24/2008
Inorganics										
Aluminum	Chronic	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	CNS	100	PPRTV	10/23/2006
Arsenic	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, CVS	3/1	IRS	4/24/2008
Iron	Chronic	7.0E-01	mg/kg/day	1	7.0E-01	mg/kg/day	GS	1.5	PPRTV	9/11/2006
Manganese	Chronic	2.4E-02	mg/kg/day	0.04	9.6E-04	mg/kg/day	CNS	1/3	IRS	4/24/2008
Vanadium	Chronic	1.0E-03	mg/kg/day	0.026	2.6E-05	mg/kg/day	Kidney	300	USEPA III	10/11/2007

Notes:
1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.
3 -Value is for 2-methylnaphthalene.

Definitions:
CNS = Central Nervous System
CVS = Cardiovascular system
USEPA(1) = Draft Trichloroethylene Health Risk Assessment: Synthesis and Characterization, August 2001.
USEPA III = U.S. EPA Region 3 RBC Table, October 11, 2007.
GS = Gastrointestinal system
IRIS = Integrated Risk Information System
NA = Not Applicable

TABLE 5.2
NON-CANCER TOXICITY DATA -- INHALATION
SITE 23 - UNDERDRAIN METERING PIT SAMPLING
NSB-NLON, GROTON, CONNECTICUT

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD(1)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds									
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	Chronic	2.8E-01	mg/m^3	8.0E-02	(mg/kg/day)	Liver	NA	USEPA III	10/11/2007
Trichloroethene	Chronic	3.5E-02	mg/m3	1.0E-02	(mg/kg/day)	Liver, CNS	NA	USEPA(1)	8/2001
Semivolatile Organic Compounds									
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	3.0E-03	mg/m^3	8.6E-04	(mg/kg/day)	Nasal	3000/1	IRIS	4/24/2008
Inorganics									
Aluminum	Chronic	0.005	mg/m3	1.4E-03	(mg/kg/day)	CNS	300	PPRTV	10/23/2006
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Chronic	5.0E-05	mg/m^3	1.4E-05	(mg/kg/day)	CNS	1000/1	IRIS	4/24/2008
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

1 - Extrapolated RfD = RfC *$20m^3$/day / 70 kg

Definitions:

CNS = Central Nervous System

EPA III = U.S. EPA Region 3 RBC Table, October 11, 2007.

HEAST= Health Effects Assessment Summary Tables

IRIS = Integrated Risk Information System

NA = Not Applicable

USEPA(1) = Draft Trichloroethylene Health Risk Assessment: Synthesis and Characterization, August 2001.

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 23 - UNDERDRAIN METERING PIT SAMPLING
NSB-NLON, GROTON, CONNECTICUT

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal[1]	Absorbed Cancer Slope Factor for Dermal[2]		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds								
Bromodichloromethane	6.2E-02	(mg/kg/day)-1	1	6.2E-02	(mg/kg/day)-1	B2	IRIS	4/24/2008
Chloroform	NA	NA	NA	NA	NA	B2	IRIS	4/24/2008
Tetrachloroethene	5.4E-01	(mg/kg/day)-1	1	5.4E-01	(mg/kg/day)-1	NA	IRIS	4/24/2008
Trichloroethene	4.0E-01	(mg/kg/day)-1	1	4.0E-01	(mg/kg/day)-1	C	USEPA(1)	8/2001
Semivolatile Organic Compounds								
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	7.3E-01	(mg/kg/day)-1	1	7.3E-01	(mg/kg/day)-1	B2	USEPA(2)	7/1993
Benzo(a)pyrene	7.3E+00	(mg/kg/day)-1	1	7.3E+00	(mg/kg/day)-1	B2	IRIS	7/20/2007
Benzo(b)fluoranthene	7.3E-01	(mg/kg/day)-1	1	7.3E-01	(mg/kg/day)-1	B2	USEPA(2)	7/1993
Benzo(k)fluoranthene	7.3E-02	(mg/kg/day)-1	1	7.3E-02	(mg/kg/day)-1	B2	USEPA(2)	7/1993
Dibenzo(a,h)anthracene	7.3E+00	(mg/kg/day)-1	1	7.3E+00	(mg/kg/day)-1	B2	USEPA(2)	7/1993
Hexachlorobenzene	1.6E+00	(mg/kg/day)-1	1	1.6E+00	(mg/kg/day)-1	B2	IRIS	4/24/2008
Indeno(1,2,3-cd)pyrene	7.3E-01	(mg/kg/day)-1	1	7.3E-01	(mg/kg/day)-1	B2	USEPA(2)	7/1993
Naphthalene	NA	NA	NA	NA	NA	C	IRIS	4/24/2008
Inorganics								
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A	IRIS	4/24/2008
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	D	IRIS	4/24/2008
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency for Dermal.
USEPA III = U.S. EPA Region 3 RBC Table, October 11, 2007.
IRIS = Integrated Risk Information System.
NA = Not Available.
USEPA(1) = Draft Trichloroethylene Health Risk Assessment: Synthesis and Characterization, August 2001.
USEPA(2) = U.S. EPA, Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, July 1993, EPA/600/R-93/089.

EPA Group:
A - Human carcinogen.
B1 - Probable human carcinogen - indicates that limited human data are available.
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .
C - Possible human carcinogen.
D - Not classifiable as a human carcinogen.
E - Evidence of noncarcinogenicity.

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
SITE 23 - UNDERDRAIN METERING PIT SAMPLING
NSB-NLON, GROTON, CONNECTICUT

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor(1)		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds							
Bromodichloromethane	NA	NA	NA	NA	B2	IRIS	4/24/2008
Chloroform	2.3E-05	$(ug/m^3)^{-1}$	8.1E-02	$(mg/kg/day)^{-1}$	B2	IRIS	4/24/2008
Tetrachloroethene	5.7E-06	$(ug/m^3)^{-1}$	2.0E-02	$(mg/kg/day)^{-1}$	NA	USEPA III	10/11/2007
Trichloroethene	1.1E-04	(ug/m3)-1	4.0E-01	(mg/kg/day)-1	C	USEPA(1)	8/2001
Semivolatile Organic Compounds							
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	4/24/2008
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	4/24/2008
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	8.9E-04	$(ug/m^3)^{-1}$	3.1E+00	$(mg/kg/day)^{-1}$	NA	USEPA III	10/11/2007
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	4.6E-04	$(ug/m^3)^{-1}$	1.6E+00	$(mg/kg/day)^{-1}$	B2	IRIS	4/24/2008
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA
Naphthalene	NA	NA	NA	NA	C	IRIS	4/24/2008
Inorganics							
Aluminum	NA	NA	NA	NA	NA	NA	NA
Arsenic	4.3E-03	$(ug/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A	IRIS	4/24/2008
Iron	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	D	IRIS	4/24/2008
Vanadium	NA	NA	NA	NA	NA	NA	NA

Notes:
1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

Definitions:
IRIS = Integrated Risk Information System.
NA = Not Available.
USEPA III = U.S. EPA Region 3 RBC Table, October 11, 2007.
USEPA(1) = Draft Trichloroethylene Health Risk Assessment: Synthesis and Characterization, August 2001.

EPA Group:
A - Human carcinogen.
B1 - Probable human carcinogen - indicates that limited human data are available.
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .
C - Possible human carcinogen.
D - Not classifiable as a human carcinogen.
E - Evidence of noncarcinogenicity.

TABLE 7.1.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site 23	Dermal	Bromodichloromethane	0.300	ug/L	4.4E-10	(mg/kg/day)	6.2E-02	(mg/kg/day)$^{-1}$	2.7E-11	3.1E-08	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.000002
				Chloroform	2.500	ug/L	4.6E-09	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	3.2E-07	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.00003
				Tetrachloroethene	0.400	ug/L	4.1E-09	(mg/kg/day)	5.4E-01	(mg/kg/day)$^{-1}$	2.2E-09	2.9E-07	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.00003
				Trichloroethene	0.500	ug/L	1.6E-09	(mg/kg/day)	4.0E-01	(mg/kg/day)$^{-1}$	6.5E-10	1.1E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0004
				1-Methylnaphthalene	0.492	ug/L	1.1E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	8.0E-07	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.0002
				2-Methylnaphthalene	0.600	ug/L	1.4E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	9.7E-07	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.0002
				Benzo(a)anthracene	1	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.2	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.3	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	0.32	ug/L	0.0E+00	(mg/kg/day)	7.3E-02	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.12	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Hexachlorobenzene	0.65	ug/L	4.9E-08	(mg/kg/day)	1.6E+00	(mg/kg/day)$^{-1}$	7.9E-08	3.4E-06	(mg/kg/day)	8.0E-04	(mg/kg/day)	0.004
				Indeno(1,2,3-cd)pyrene	0	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Naphthalene	1	ug/L	6.6E-09	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	4.6E-07	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.00002
				Aluminum	322.00	ug/L	7.1E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	5.0E-06	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.000005
				Arsenic	13.90	ug/L	3.1E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	4.6E-09	2.2E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0007
				Iron	70800.00	ug/L	1.6E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.1E-03	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.002
				Manganese	845.0	ug/L	1.9E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.3E-05	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.01
				Vanadium	3.7	ug/L	8.2E-10	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	5.7E-08	(mg/kg/day)	2.6E-05	(mg/kg/day)	0.002
			Exp. Route Total								8.6E-08					0.02
		Exposure Point Total									8.6E-08					0.02
	Exposure Medium Total										8.6E-08					0.02
	Air	Site 23	Inhalation	Bromodichloromethane	8.4E-6	mg/m3	1.4E-09	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	9.9E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Chloroform	8.4E-5	mg/m3	1.4E-08	(mg/kg/day)	8.1E-02	(mg/kg/day)$^{-1}$	1.1E-09	9.8E-07	(mg/kg/day)	1.4E-02	(mg/kg/day)	0.00007
				Tetrachloroethene	1.1E-5	mg/m3	1.9E-09	(mg/kg/day)	2.0E-02	(mg/kg/day)$^{-1}$	3.9E-11	1.3E-07	(mg/kg/day)	8.0E-02	(mg/kg/day)	0.000002
				Trichloroethene	1.6E-5	mg/m3	2.7E-09	(mg/kg/day)	4.0E-01	(mg/kg/day)$^{-1}$	1.1E-09	1.9E-07	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.00002
				1-Methylnaphthalene	1.4E-5	mg/m3	2.4E-09	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.7E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				2-Methylnaphthalene	9.5E-6	mg/m3	1.6E-09	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.1E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)anthracene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	3.1E+00	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Hexachlorobenzene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	1.6E+00	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Naphthalene	1.6E-5	mg/m3	2.7E-09	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.9E-07	(mg/kg/day)	9.0E-04	(mg/kg/day)	0.0002
				Aluminum	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	1.4E-03	(mg/kg/day)	--
				Arsenic	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	1.5E+01	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Iron	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	1.4E-05	(mg/kg/day)	--
				Vanadium	0.0E+0	mg/m3	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								2.3E-09					0.0003
		Exposure Point Total									2.3E-09					0.0003
	Exposure Medium Total										2.3E-09					0.0003
Medium Total											8.8E-08					0.02
										Total of Receptor Risks Across All Media	8.8E-08				Total of Receptor Hazards Across All Media	0.02

5/15/2008

TABLE 7.2.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site 23	Ingestion	Bromodichloromethane	0.300	ug/L	2.5E-06	(mg/kg/day)	6.2E-02	(mg/kg/day)$^{-1}$	1.5E-07	2.9E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.001
				Chloroform	2.500	ug/L	2.1E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	2.4E-04	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.02
				Tetrachloroethene	0.400	ug/L	3.3E-06	(mg/kg/day)	5.4E-01	(mg/kg/day)$^{-1}$	1.8E-06	3.8E-05	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.004
				Trichloroethene	0.500	ug/L	4.1E-06	(mg/kg/day)	4.0E-01	(mg/kg/day)$^{-1}$	1.6E-06	4.8E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.2
				1-Methylnaphthalene	0.492	ug/L	4.0E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	4.7E-05	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.01
				2-Methylnaphthalene	0.600	ug/L	4.9E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	5.8E-05	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.01
				Benzo(a)anthracene	0.510	ug/L	2.2E-05	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	1.6E-05	4.9E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.225	ug/L	9.9E-06	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	7.2E-05	2.2E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.340	ug/L	1.5E-05	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	1.1E-05	3.3E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	0.315	ug/L	1.4E-05	(mg/kg/day)	7.3E-02	(mg/kg/day)$^{-1}$	1.0E-06	3.0E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.120	ug/L	5.3E-06	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	3.8E-05	1.2E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Hexachlorobenzene	0.650	ug/L	5.3E-06	(mg/kg/day)	1.6E+00	(mg/kg/day)$^{-1}$	8.5E-06	6.2E-05	(mg/kg/day)	8.0E-04	(mg/kg/day)	0.08
				Indeno(1,2,3-cd)pyrene	0.160	ug/L	7.0E-06	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	5.1E-06	1.5E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Naphthalene	0.552	ug/L	4.5E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	5.3E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.003
				Aluminum	322	ug/L	2.6E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	3.1E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.03
				Arsenic	13.90	ug/L	1.1E-04	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1.7E-04	1.3E-03	(mg/kg/day)	3.0E-04	(mg/kg/day)	4.4
				Iron	70800	ug/L	5.8E-01	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	6.8E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	9.7
				Manganese	845	ug/L	6.9E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	8.1E-02	(mg/kg/day)	2.4E-02	(mg/kg/day)	3.4
				Vanadium	3.70	ug/L	3.0E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	3.5E-04	(mg/kg/day)	1.0E-03	(mg/kg/day)	0.4
			Exp. Route Total								3.3E-04					18
			Dermal	Bromodichloromethane	0.300	ug/L	2.2E-08	(mg/kg/day)	6.2E-02	(mg/kg/day)$^{-1}$	1.3E-09	7.6E-07	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.00004
				Chloroform	2.500	ug/L	2.0E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	7.0E-06	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.0007
				Tetrachloroethene	0.400	ug/L	2.1E-07	(mg/kg/day)	5.4E-01	(mg/kg/day)$^{-1}$	1.1E-07	7.4E-06	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.0007
				Trichloroethene	0.500	ug/L	7.4E-08	(mg/kg/day)	4.0E-01	(mg/kg/day)$^{-1}$	3.0E-08	2.6E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.009
				1-Methylnaphthalene	0.492	ug/L	6.0E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	2.1E-05	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.005
				2-Methylnaphthalene	0.600	ug/L	7.2E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	2.5E-05	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.006
				Benzo(a)anthracene	0.510	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.225	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.340	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	0.315	ug/L	0.0E+00	(mg/kg/day)	7.3E-02	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.120	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Hexachlorobenzene	0.650	ug/L	2.7E-06	(mg/kg/day)	1.6E+00	(mg/kg/day)$^{-1}$	4.3E-06	9.4E-05	(mg/kg/day)	8.0E-04	(mg/kg/day)	0.1
				Indeno(1,2,3-cd)pyrene	0.160	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Naphthalene	0.552	ug/L	3.2E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	1.1E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0006
				Aluminum	322	ug/L	9.7E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	3.4E-05	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.00003
				Arsenic	13.90	ug/L	4.2E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	6.3E-08	1.5E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.005
				Iron	70800	ug/L	2.1E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	7.5E-03	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.01
				Manganese	845	ug/L	2.5E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	8.9E-05	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.09
				Vanadium	3.70	ug/L	1.1E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	3.9E-07	(mg/kg/day)	2.6E-05	(mg/kg/day)	0.02
			Exp. Route Total								4.5E-06					0.3
		Exposure Point Total									3.3E-04					18
	Exposure Medium Total										3.3E-04					18

TABLE 7.2.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Air	Site 23	Inhalation	Bromodichloromethane	0.300	ug/L	2.5E-06	(mg/kg/day)	6.2E-02	(mg/kg/day)$^{-1}$	1.5E-07	2.9E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.001
				Chloroform	2.500	ug/L	2.1E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	2.4E-04	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.02
				Tetrachloroethene	0.400	ug/L	3.3E-06	(mg/kg/day)	5.4E-01	(mg/kg/day)$^{-1}$	1.8E-06	3.8E-05	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.004
				Trichloroethene	0.500	ug/L	4.1E-06	(mg/kg/day)	4.0E-01	(mg/kg/day)$^{-1}$	1.6E-06	4.8E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.2
				1-Methylnaphthalene	0.492	ug/L	4.0E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	4.7E-05	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.01
				2-Methylnaphthalene	0.600	ug/L	4.9E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	5.8E-05	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.01
				Benzo(a)anthracene	0.510	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.225	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.340	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	0.315	ug/L	0.0E+00	(mg/kg/day)	7.3E-02	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.120	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Hexachlorobenzene	0.650	ug/L	0.0E+00	(mg/kg/day)	1.6E+00	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	8.0E-04	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	0.160	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Naphthalene	0.552	ug/L	4.5E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	5.3E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.003
				Aluminum	322	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Arsenic	13.90	ug/L	0.0E+00	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Iron	70800	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	845	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	2.4E-02	(mg/kg/day)	--
				Vanadium	3.70	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	--	0.0E+00	(mg/kg/day)	1.0E-03	(mg/kg/day)	--
			Exp. Route Total								3.6E-06					0.2
		Exposure Point Total									3.6E-06					0.2
	Exposure Medium Total										3.6E-06					0.2
Medium Total											3.4E-04					19
										Total of Receptor Risks Across All Media	3.4E-04				Total of Receptor Hazards Across All Media	19

Note:
Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site 23	Ingestion	Bromodichloromethane	0.300	ug/L	2.3E-06	(mg/kg/day)	6.2E-02	$(mg/kg/day)^{-1}$	1.5E-07	2.0E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0010
				Chloroform	2.500	ug/L	2.0E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	1.6E-04	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.02
				Tetrachloroethene	0.400	ug/L	3.1E-06	(mg/kg/day)	5.4E-01	$(mg/kg/day)^{-1}$	1.7E-06	2.6E-05	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.003
				Trichloroethene	0.500	ug/L	3.9E-06	(mg/kg/day)	4.0E-01	$(mg/kg/day)^{-1}$	1.6E-06	3.3E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.1
				1-Methylnaphthalene	0.492	ug/L	3.9E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	3.2E-05	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.008
				2-Methylnaphthalene	0.600	ug/L	4.7E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	3.9E-05	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.010
				Benzo(a)anthracene	0.510	ug/L	8.0E-06	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	5.8E-06	3.4E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.225	ug/L	3.5E-06	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.6E-05	1.5E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.340	ug/L	5.3E-06	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	3.9E-06	2.2E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	0.315	ug/L	4.9E-06	(mg/kg/day)	7.3E-02	$(mg/kg/day)^{-1}$	3.6E-07	2.1E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.120	ug/L	1.9E-06	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.4E-05	7.9E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Hexachlorobenzene	0.650	ug/L	5.1E-06	(mg/kg/day)	1.6E+00	$(mg/kg/day)^{-1}$	8.1E-06	4.3E-05	(mg/kg/day)	8.0E-04	(mg/kg/day)	0.05
				Indeno(1,2,3-cd)pyrene	0.160	ug/L	2.5E-06	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	1.8E-06	1.1E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Naphthalene	0.552	ug/L	4.3E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	3.6E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.002
				Aluminum	322	ug/L	2.5E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	2.1E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.02
				Arsenic	13.90	ug/L	1.1E-04	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.6E-04	9.1E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	3.0
				Iron	70800	ug/L	5.5E-01	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	4.7E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	6.7
				Manganese	845	ug/L	6.6E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	5.6E-02	(mg/kg/day)	2.4E-02	(mg/kg/day)	2.3
				Vanadium	3.70	ug/L	2.9E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	2.4E-04	(mg/kg/day)	1.0E-03	(mg/kg/day)	0.2
			Exp. Route Total								2.3E-04					12
			Dermal	Bromodichloromethane	0.300	ug/L	1.5E-07	(mg/kg/day)	6.2E-02	$(mg/kg/day)^{-1}$	9.4E-09	1.1E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.00005
				Chloroform	2.500	ug/L	1.4E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	9.8E-06	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.0010
				Tetrachloroethene	0.400	ug/L	1.5E-06	(mg/kg/day)	5.4E-01	$(mg/kg/day)^{-1}$	8.0E-07	1.0E-05	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.001
				Trichloroethene	0.500	ug/L	5.2E-07	(mg/kg/day)	4.0E-01	$(mg/kg/day)^{-1}$	2.1E-07	3.6E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.01
				1-Methylnaphthalene	0.492	ug/L	4.2E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	3.0E-05	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.007
				2-Methylnaphthalene	0.600	ug/L	5.1E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	3.6E-05	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.009
				Benzo(a)anthracene	0.510	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.225	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.340	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	0.315	ug/L	0.0E+00	(mg/kg/day)	7.3E-02	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.120	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Hexachlorobenzene	0.650	ug/L	1.9E-05	(mg/kg/day)	1.6E+00	$(mg/kg/day)^{-1}$	3.0E-05	1.3E-04	(mg/kg/day)	8.0E-04	(mg/kg/day)	0.2
				Indeno(1,2,3-cd)pyrene	0.160	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	$(mg/kg/day)^{-1}$	--	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Naphthalene	0.552	ug/L	2.2E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	1.6E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0008
				Aluminum	322	ug/L	6.8E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	4.8E-05	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.00005
				Arsenic	13.90	ug/L	2.9E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.4E-07	2.1E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.007
				Iron	70800	ug/L	1.5E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	1.0E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.01
				Manganese	845	ug/L	1.8E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	1.3E-04	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.1
				Vanadium	3.70	ug/L	7.8E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	--	5.5E-07	(mg/kg/day)	2.6E-05	(mg/kg/day)	0.02
			Exp. Route Total								3.1E-05					0.4
		Exposure Point Total									2.6E-04					13
	Exposure Medium Total										2.6E-04					13

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Air	Site 23	Inhalation	Bromodichloromethane	0.300	ug/L	2.3E-06	(mg/kg/day)	6.2E-02	(mg/kg/day)$^{-1}$	1.5E-07	2.0E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0010
				Chloroform	2.500	ug/L	2.0E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.6E-04	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.02
				Tetrachloroethene	0.400	ug/L	3.1E-06	(mg/kg/day)	5.4E-01	(mg/kg/day)$^{-1}$	1.7E-06	2.6E-05	(mg/kg/day)	1.0E-02	(mg/kg/day)	0.003
				Trichloroethene	0.500	ug/L	3.9E-06	(mg/kg/day)	4.0E-01	(mg/kg/day)$^{-1}$	1.6E-06	3.3E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.1
				1-Methylnaphthalene	0.492	ug/L	3.9E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.2E-05	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.008
				2-Methylnaphthalene	0.600	ug/L	4.7E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.9E-05	(mg/kg/day)	4.0E-03	(mg/kg/day)	0.010
				Benzo(a)anthracene	0.510	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(a)pyrene	0.225	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(b)fluoranthene	0.340	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Benzo(k)fluoranthene	0.315	ug/L	0.0E+00	(mg/kg/day)	7.3E-02	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Dibenzo(a,h)anthracene	0.120	ug/L	0.0E+00	(mg/kg/day)	7.3E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Hexachlorobenzene	0.650	ug/L	0.0E+00	(mg/kg/day)	1.6E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	8.0E-04	(mg/kg/day)	--
				Indeno(1,2,3-cd)pyrene	0.160	ug/L	0.0E+00	(mg/kg/day)	7.3E-01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Naphthalene	0.552	ug/L	4.3E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.6E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.002
				Aluminum	322	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Arsenic	13.90	ug/L	0.0E+00	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Iron	70800	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	845	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.4E-02	(mg/kg/day)	--
				Vanadium	3.70	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-03	(mg/kg/day)	--
			Exp. Route Total								3.4E-06					0.1
		Exposure Point Total									3.4E-06					0.1
	Exposure Medium Total										3.4E-06					0.1
Medium Total											2.6E-04					13
										Total of Receptor Risks Across All Media	2.6E-04				Total of Receptor Hazards Across All Media	13

Note:
Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Bromodichloromethane	--	--	3E-11	--	3E-11	Kidney	--	--	0.000002	0.000002
			Chloroform	--	--	--	--	--	Liver	--	--	0.00003	0.00003
			Tetrachloroethene	--	--	2E-09	--	2E-09	Liver	--	--	0.00003	0.00003
			Trichloroethene	--	--	6E-10	--	6E-10	Liver, Kidney	--	--	0.0004	0.0004
			1-Methylnaphthalene	--	--	--	--	--	Lungs	--	--	0.0002	0.0002
			2-Methylnaphthalene	--	--	--	--	--	Lungs	--	--	0.0002	0.0002
			Benzo(a)anthracene	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)pyrene	--	--	--	--	--	NA	--	--	--	--
			Benzo(b)fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Benzo(k)fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Dibenzo(a,h)anthracene	--	--	--	--	--	NA	--	--	--	--
			Hexachlorobenzene	--	--	8E-08	--	8E-08	Liver	--	--	0.004	0.004
			Indeno(1,2,3-cd)pyrene	--	--	--	--	--	NA	--	--	--	--
			Naphthalene	--	--	--	--	--	Body Weight	--	--	0.00002	0.00002
			Aluminum	--	--	--	--	--	CNS	--	--	0.000005	0.000005
			Arsenic	--	--	5E-09	--	5E-09	Skin, CVS	--	--	0.0007	0.0007
			Iron	--	--	--	--	--	GS	--	--	0.002	0.002
			Manganese	--	--	--	--	--	CNS	--	--	0.01	0.01
			Vanadium	--	--	--	--	--	Kidney	--	--	0.002	0.002
			Chemical Total	--	--	9E-08	--	9E-08		--	--	0.02	0.02
		Exposure Point Total						9E-08					0.02
	Exposure Medium Total							9E-08					0.02
	Groundwater	Site 23	Bromodichloromethane	--	--	--	--	--	NA	--	--	--	--
			Chloroform	--	1E-09	--	--	1E-09	Liver	--	0.00007	--	0.00007
			Tetrachloroethene	--	4E-11	--	--	4E-11	Liver	--	0.000002	--	0.000002
			Trichloroethene	--	1E-09	--	--	1E-09	Liver, CNS	--	0.00002	--	0.00002
			1-Methylnaphthalene	--	--	--	--	--	NA	--	--	--	--
			2-Methylnaphthalene	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)pyrene	--	--	--	--	--	NA	--	--	--	--
			Benzo(b)fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Benzo(k)fluoranthene	--	--	--	--	--	NA	--	--	--	--
			Dibenzo(a,h)anthracene	--	--	--	--	--	NA	--	--	--	--
			Hexachlorobenzene	--	--	--	--	--	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	--	--	--	--	NA	--	--	--	--

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future	
Receptor Population: Construction Workers	
Receptor Age: Adult	

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Naphthalene	--	--	--	--	--	NA	--	0.0002	--	0.0002
			Aluminum	--	--	--	--	--	CNS	--	--	--	--
			Arsenic	--	--	--	--	--	NA	--	--	--	--
			Iron	--	--	--	--	--	NA	--	--	--	--
			Manganese	--	--	--	--	--	CNS	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	--	--	--
			Chemical Total	--	2E-09	--	--	2E-09		--	0.0003	--	0.0003
		Exposure Point Total						2E-09					0.0003
	Exposure Medium Total							2E-09					0.0003
Medium Total								9E-08					0.02
Receptor Total							Receptor Risk Total	9E-08				Receptor HI Total	0.02

5/15/2008

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Bromodichloromethane	2E-07	--	1E-09	--	2E-07	Kidney	0.001	- -	0.00004	0.001
			Chloroform	- -	--	- -	--	- -	Liver	0.02	- -	0.0007	0.02
			Tetrachloroethene	2E-06	--	1E-07	--	2E-06	Liver	0.004	- -	0.0007	0.005
			Trichloroethene	2E-06	--	3E-08	--	2E-06	Liver, Kidney	0.2	- -	0.009	0.2
			1-Methylnaphthalene	- -	--	- -	--	- -	Lungs	0.01	- -	0.005	0.02
			2-Methylnaphthalene	- -	--	- -	--	- -	Lungs	0.01	- -	0.006	0.02
			Benzo(a)anthracene	2E-05	--	- -	--	2E-05	NA	--	- -	--	--
			Benzo(a)pyrene	7E-05	--	- -	--	7E-05	NA	--	- -	--	--
			Benzo(b)fluoranthene	1E-05	--	- -	--	1E-05	NA	--	- -	--	--
			Benzo(k)fluoranthene	1E-06	--	- -	--	1E-06	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	4E-05	--	- -	--	4E-05	NA	--	- -	--	--
			Hexachlorobenzene	9E-06	--	4E-06	--	1E-05	Liver	0.08	- -	0.1	0.2
			Indeno(1,2,3-cd)pyrene	5E-06	--	- -	--	5E-06	NA	--	- -	--	--
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.003	- -	0.0006	0.003
			Aluminum	- -	--	- -	--	- -	CNS	0.03	- -	0.00003	0.03
			Arsenic	2E-04	--	6E-08	--	2E-04	Skin, CVS	4	- -	0.005	4
			Iron	- -	--	- -	--	- -	GS	10	- -	0.01	10
			Manganese	- -	--	- -	--	- -	CNS	3	- -	0.09	3
			Vanadium	- -	--	- -	--	- -	Kidney	0.4	- -	0.02	0.4
			Chemical Total	3E-04	--	4E-06	--	3E-04		18	- -	0.3	18
		Exposure Point Total						3E-04					18
	Exposure Medium Total							3E-04					18
	Groundwater	Site 23	Bromodichloromethane	--	2E-07	--	--	2E-07	NA	- -	0.001	- -	0.001
			Chloroform	--	- -	--	--	- -	Liver	- -	0.02	- -	0.02
			Tetrachloroethene	--	2E-06	--	--	2E-06	Liver	- -	0.004	- -	0.004
			Trichloroethene	--	2E-06	--	--	2E-06	Liver, CNS	- -	0.2	- -	0.2
			1-Methylnaphthalene	--	- -	--	--	- -	NA	- -	0.01	- -	0.01
			2-Methylnaphthalene	--	- -	--	--	- -	NA	- -	0.01	- -	0.01
			Benzo(a)anthracene	--	- -	--	--	- -	NA	- -	--	- -	--
			Benzo(a)pyrene	--	- -	--	--	- -	NA	- -	--	- -	--
			Benzo(b)fluoranthene	--	- -	--	--	- -	NA	- -	--	- -	--
			Benzo(k)fluoranthene	--	- -	--	--	- -	NA	- -	--	- -	--
			Dibenzo(a,h)anthracene	--	- -	--	--	- -	NA	- -	--	- -	--
			Hexachlorobenzene	--	- -	--	--	- -	NA	- -	--	- -	--
			Indeno(1,2,3-cd)pyrene	--	- -	--	--	- -	NA	- -	--	- -	--

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Naphthalene	--	--	--	--	--	NA	--	0.003	--	0.003
			Aluminum	--	--	--	--	--	CNS	--	--	--	--
			Arsenic	--	--	--	--	--	NA	--	--	--	--
			Iron	--	--	--	--	--	NA	--	--	--	--
			Manganese	--	--	--	--	--	CNS	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	--	--	--
			Chemical Total	--	4E-06	--	--	4E-06		--	0.2	--	0.2
		Exposure Point Total						4E-06					0.2
	Exposure Medium Total							4E-06					0.2
Medium Total								3E-04					19
Receptor Total							Receptor Risk Total	3E-04				Receptor HI Total	19

Note:

Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

Total Body Weight HI	0.003
Total CNS HI	4
Total CVS HI	4
Total GS HI	10
Total Kidney HI	0.5
Total Liver HI	0.6
Total Skin HI	4

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Bromodichloromethane	1E-07	--	9E-09	--	2E-07	Kidney	0.0010	- -	0.00005	0.001
			Chloroform	- -	--	- -	--	- -	Liver	0.02	- -	0.0010	0.02
			Tetrachloroethene	2E-06	--	8E-07	--	2E-06	Liver	0.003	- -	0.001	0.004
			Trichloroethene	2E-06	--	2E-07	--	2E-06	Liver, Kidney	0.1	- -	0.01	0.1
			1-Methylnaphthalene	- -	--	- -	--	- -	Lungs	0.008	- -	0.007	0.02
			2-Methylnaphthalene	- -	--	- -	--	- -	Lungs	0.010	- -	0.009	0.02
			Benzo(a)anthracene	6E-06	--	- -	--	6E-06	NA	--	- -	--	--
			Benzo(a)pyrene	3E-05	--	- -	--	3E-05	NA	--	- -	--	--
			Benzo(b)fluoranthene	4E-06	--	- -	--	4E-06	NA	--	- -	--	--
			Benzo(k)fluoranthene	4E-07	--	- -	--	4E-07	NA	--	- -	--	--
			Dibenzo(a,h)anthracene	1E-05	--	- -	--	1E-05	NA	--	- -	--	--
			Hexachlorobenzene	8E-06	--	3E-05	--	4E-05	Liver	0.05	- -	0.2	0.2
			Indeno(1,2,3-cd)pyrene	2E-06	--	- -	--	2E-06	NA	--	- -	--	--
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.002	- -	0.0008	0.003
			Aluminum	- -	--	- -	--	- -	CNS	0.02	- -	0.00005	0.02
			Arsenic	2E-04	--	4E-07	--	2E-04	Skin, CVS	3	- -	0.007	3
			Iron	- -	--	- -	--	- -	GS	7	- -	0.01	7
			Manganese	- -	--	- -	--	- -	CNS	2	- -	0.1	2
			Vanadium	- -	--	- -	--	- -	Kidney	0.2	- -	0.02	0.3
			Chemical Total	2E-04	--	3E-05	--	3E-04		12	- -	0.4	13
		Exposure Point Total						3E-04					13
	Exposure Medium Total							3E-04					13
	Groundwater	Site 23	Bromodichloromethane	--	1E-07	--	--	1E-07	NA	- -	0.0010	- -	0.0010
			Chloroform	--	- -	--	--	- -	Liver	- -	0.02	- -	0.02
			Tetrachloroethene	--	2E-06	--	--	2E-06	Liver	- -	0.003	- -	0.003
			Trichloroethene	--	2E-06	--	--	2E-06	Liver, CNS	- -	0.1	- -	0.1
			1-Methylnaphthalene	--	- -	--	--	- -	NA	- -	0.008	- -	0.008
			2-Methylnaphthalene	--	- -	--	--	- -	NA	- -	0.010	- -	0.010
			Benzo(a)anthracene	--	- -	--	--	- -	NA	- -	--	- -	--
			Benzo(a)pyrene	--	- -	--	--	- -	NA	- -	--	- -	--
			Benzo(b)fluoranthene	--	- -	--	--	- -	NA	- -	--	- -	--
			Benzo(k)fluoranthene	--	- -	--	--	- -	NA	- -	--	- -	--
			Dibenzo(a,h)anthracene	--	- -	--	--	- -	NA	- -	--	- -	--
			Hexachlorobenzene	--	- -	--	--	- -	NA	- -	--	- -	--
			Indeno(1,2,3-cd)pyrene	--	- -	--	--	- -	NA	- -	--	- -	--

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Naphthalene	--	--	--	--	--	NA	--	0.002	--	0.002
			Aluminum	--	--	--	--	--	CNS	--	--	--	--
			Arsenic	--	--	--	--	--	NA	--	--	--	--
			Iron	--	--	--	--	--	NA	--	--	--	--
			Manganese	--	--	--	--	--	CNS	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	--	--	--
			Chemical Total	--	3E-06	--	--	3E-06		--	0.1	--	0.1
		Exposure Point Total						3E-06					0.1
	Exposure Medium Total							3E-06					0.1
Medium Total								3E-04					13
Receptor Total							Receptor Risk Total	3E-04				Receptor HI Total	13

Note:
Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

Total Body Weight HI	0.003
Total CNS HI	3
Total CVS HI	3
Total GS HI	7
Total Kidney HI	0.4
Total Liver HI	0.5
Total Skin HI	3

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Bromodichloromethane	3E-07	--	1E-08	--	3E-07					
			Chloroform	- -	--	- -	--	- -					
			Tetrachloroethene	3E-06	--	9E-07	--	4E-06					
			Trichloroethene	3E-06	--	2E-07	--	3E-06					
			1-Methylnaphthalene	- -	--	- -	--	- -					
			2-Methylnaphthalene	- -	--	- -	--	- -					
			Benzo(a)anthracene	2E-05	--	- -	--	2E-05					
			Benzo(a)pyrene	1E-04	--	- -	--	1E-04					
			Benzo(b)fluoranthene	1E-05	--	- -	--	1E-05					
			Benzo(k)fluoranthene	1E-06	--	- -	--	1E-06					
			Dibenzo(a,h)anthracene	5E-05	--	- -	--	5E-05					
			Hexachlorobenzene	2E-05	--	3E-05	--	5E-05					
			Indeno(1,2,3-cd)pyrene	7E-06	--	- -	--	7E-06					
			Naphthalene	- -	--	- -	--	- -					
			Aluminum	- -	--	- -	--	- -					
			Arsenic	3E-04	--	5E-07	--	3E-04					
			Iron	- -	--	- -	--	- -					
			Manganese	- -	--	- -	--	- -					
			Vanadium	- -	--	- -	--	- -					
			Chemical Total	6E-04	--	4E-05	--	6E-04					
		Exposure Point Total						6E-04					
	Exposure Medium Total							6E-04					
	Groundwater	Site 23	Bromodichloromethane	--	3E-07	--	--	3E-07					
			Chloroform	--	- -	--	--	- -					
			Tetrachloroethene	--	3E-06	--	--	3E-06					
			Trichloroethene	--	3E-06	--	--	3E-06					
			1-Methylnaphthalene	--	- -	--	--	- -					
			2-Methylnaphthalene	--	- -	--	--	- -					
			Benzo(a)anthracene	--	- -	--	--	- -					
			Benzo(a)pyrene	--	- -	--	--	- -					
			Benzo(b)fluoranthene	--	- -	--	--	- -					
			Benzo(k)fluoranthene	--	- -	--	--	- -					
			Dibenzo(a,h)anthracene	--	- -	--	--	- -					
			Hexachlorobenzene	--	- -	--	--	- -					
			Indeno(1,2,3-cd)pyrene	--	- -	--	--	- -					

5/15/2008

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES - UNDERDRAIN METERING PIT
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site 23	Naphthalene	--	--	--	--	--					
			Aluminum	--	--	--	--	--					
			Arsenic	--	--	--	--	--					
			Iron	--	--	--	--	--					
			Manganese	--	--	--	--	--					
			Vanadium	--	--	--	--	--					
			Chemical Total	--	7E-06	--	--	7E-06					
		Exposure Point Total						7E-06					
	Exposure Medium Total							7E-06					
Medium Total								6E-04					
Receptor Total							Receptor Risk Total	6E-04					

Note:
Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

APPENDIX E

VAPOR INTRUSION EVALUATION FOR GROUNDWATER MEMORANDUM

From: Bob Jupin, Tetra Tech Risk Assessment Specialist
To: Corey Rich, Tetra Tech Project Manager
Date: May 30, 2008

Regarding: Vapor Intrusion Evaluation for Groundwater at Operable Unit (OU) 9

Groundwater data from Sites 2, 3, 7, 14, 15, 18, 20, and 23 which are within OU 9 were evaluated to determine if there were unacceptable risks associated with vapor intrusion into buildings. The most recent groundwater data that was available for each site was used in the evaluation. Concentrations of volatile organic compounds (VOCs) in groundwater were compared to screening criteria for vapor intrusion. Screening criteria were obtained from USEPA's *OSWER Draft Guidance for Evaluating the Vapor Intrusion into Indoor Air from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), November 2002,* CTDEP's *Proposed Revisions - Connecticut's Remediation Standard Regulations Volatilization Criteria, March 2003,* and USEPA Region I (April 24, 2008). The screening criteria are for residential exposures and are based on an incremental lifetime cancer risk (ILCR) of 1×10^{-6} or a hazard index (HI) of 1. If the risk-based screening criterion is less than the maximum contaminant level (MCL) the 2002 USEPA guidance recommends using the MCL as the screening level. However, USEPA Region I guidance does not allow for MCLs to be used as screening criteria. USEPA Region I provided risk-based screening levels for those cases where the USEPA draft guidance recommended MCLs as screening levels. If chemicals were detected at concentrations exceeding either screening criteria, then the chemicals were further evaluated using USEPA's Johnson and Ettinger Vapor Intrusion Model (USEPA, February 2004). The results of the screening and modeling evaluations are presented below.

COMPARISON TO SCREENING CRITERIA FOR VAPOR INTRUSION

Site 2

Groundwater data presented in the Year 3 Annual Groundwater Monitoring Report for Area A Landfill (Tetra Tech, 2003) was used to evaluate the potential for vapor intrusion at Site 2. This was the last year that VOCs were analyzed for in groundwater samples collected at Site 2. VOCs were eliminated as a concern at Site 2 after eleven rounds of groundwater monitoring. A comparison of the detected concentrations of VOCs in groundwater samples from upgradient wells, downgradient wells in Area A Downstream, and downgradient wells in the Area A Wetland to the screening criteria are presented in Tables 1 through 3, respectively. Concentrations of all chemicals were below the CTDEP RSRs for vapor intrusion. Concentrations of chloroform exceeded the USEPA screening criterion in samples from upgradient well 4MW01S. Concentrations of trichloroethene exceeded the USEPA screening criterion in samples from upgradient monitoring well 4MW01S; downstream monitoring well 3MW37S, and wetlands monitoring well 2WMW46DS. Concentrations of tetrachloroethene exceeded the USEPA screening criterion in samples from wetlands monitoring well 2WMW39DS. Therefore, these chemicals were further evaluated using the Johnson and Ettinger Vapor Intrusion Model.

Site 3

Groundwater data presented in the Year 1 Annual Groundwater Monitoring Report for Sites 3 and 7 (Tetra Tech, 2007) was used to evaluate the potential for vapor intrusion at Site 3. A comparison of the detected concentrations of VOCs in groundwater samples to the screening criteria is presented in Table 4. Concentrations of chloroform exceeded the USEPA screening criterion in samples from monitoring wells 3MW15S, 3MW15D, 2MW16S, and 3MW16D. Concentrations of trichloroethene exceeded USEPA screening criterion in all four samples collected from monitoring well 2DMW16D. Concentrations of vinyl chloride in monitoring well 2DMW29S exceeded the USEPA screening criterion and CTDEP RSRs in groundwater samples collected during the 1st, 2nd, and 4th quarters. Therefore, chloroform, trichloroethene, and vinyl chloride were further evaluated using the Johnson and Ettinger Vapor Intrusion Model.

Site 7

Groundwater data presented in the Year 1 Annual Groundwater Monitoring Report for Sites 3 and 7 (Tetra Tech, 2007) was used to evaluate the potential for vapor intrusion at Site 7. A comparison of the detected concentrations of VOCs in groundwater samples to the screening criterion is presented in Table 5. Concentrations of trichloroethene exceeded the USEPA screening criterion in all four samples collected from monitoring wells 7MW05D and 7MW12I. Therefore, trichloroethene was further evaluated using the Johnson and Ettinger Vapor Intrusion Model.

Site 14

No VOCs were detected in groundwater samples collected at Site 14 during the Basewide Groundwater Operable Unit Remedial Investigation (BGOURI) (Tetra Tech, 2002) indicating that vapor intrusion is not a concern at Site 14.

Site 15

Groundwater data presented in the Basewide Groundwater Operable Unit Remedial Investigation Update/Feasibility Study Report (Tetra Tech, 2004) was used to evaluate the potential for vapor intrusion at Site 15. A comparison of the detected concentrations of VOCs in groundwater samples to the screening criteria is presented in Table 6. Chloroform was the only VOC detected in groundwater samples collected at Site 15. Chloroform is a common laboratory contaminant and is frequently detected in potable water samples. Chloroform was only detected in one sample at one temporary monitoring well (15TW03) and the detected concentration exceeded the USEPA screening criterion. Therefore, chloroform was further evaluated using the Johnson and Ettinger Vapor Intrusion Model.

Site 18

No VOCs were detected in groundwater samples collected at Site 18 during the BGOURI (Tetra Tech, 2002) indicating that vapor intrusion is not a concern at Site 18.

Site 20

Groundwater data presented in the BGOURI (Tetra Tech, 2002) was used to evaluate the potential for vapor intrusion at Site 20. A comparison of the detected concentrations of VOCs in groundwater samples to the screening criteria is presented in Table 7. 4-Methyl-2-pentanone and trichloroethene were the only VOCs detected in groundwater samples collected at Site 20. Trichloroethene was detected in the groundwater sample from monitoring well 2WCMW2S at a concentration exceeding the USEPA screening criterion. Therefore, trichloroethene was further evaluated using the Johnson and Ettinger Vapor Intrusion Model.

Site 23

Groundwater data presented in Year 1 Annual Monitoring Report for Site 23 Underdrain Metering Pit (Tetra Tech, 2008) was used to evaluate the potential for vapor intrusion at Site 23. A comparison of the detected concentrations of VOCs in groundwater samples to the screening criteria are presented in Table 8. Concentrations of chloroform detected in one sample and trichloroethene detected in four samples exceeded the USEPA screening criterion. Therefore, chloroform and trichloroethene were further evaluated using the Johnson and Ettinger Vapor Intrusion Model.

VAPOR INTRUSION MODELING

The following chemicals were detected at concentrations exceeding the screening criteria for vapor intrusion:

- Site 2 Upgradient – chloroform and trichloroethene
- Site 2 Area A Downstream – trichloroethene
- Site 2 Area A Wetlands – tetrachloroethene and trichloroethene
- Site 3 – chloroform, trichloroethene, and vinyl chloride
- Site 7 – trichloroethene
- Site 15 – chloroform
- Site 20 – trichloroethene
- Site 23 – chloroform and trichloroethene

These chemicals were further evaluated using USEPA's Johnson and Ettinger Vapor Intrusion Model. There are currently no buildings at any of the sites that are used for residential purposes, although there are some buildings that are used for industrial purposes. Therefore, the evaluation considered a hypothetical scenario where a residential building was constructed at the sites.

In accordance with USEPA Region I guidance (1999), there was not sufficient data available to calculate temporal averages at the monitoring wells; therefore, the maximum detected concentrations were used as the exposure point concentrations for the chemicals identified as exceeding the screening levels at each site. The boring logs for the monitoring wells where there were exceedances of the screening criteria were used to determine the Soil Conservation Services (SCS) soil type. Test results from the BGOURI were used to determine the bulk density and total porosity. The values used in the evaluation are presented in Table 9. Supporting information for Table 9 is included in Attachment A. Slab-on-grade construction was assumed for future residential construction due to the shallow groundwater depth at Site 3. At the Site 2 Wetlands the depth to groundwater was assumed to be 2 feet which represents the average depth to groundwater at monitoring wells 2WMW39DS and 2WMW46DS. At the other sites the shallowest depth to groundwater was used in the evaluation. Default parameters were used for the remaining model input parameters for the evaluation of residential exposures.

The USEPA vapor intrusion guidance does not provide any default parameters for evaluating industrial exposures. The USEPA default values of 250 days a year and 25 years were used for the exposure frequency and exposure duration, respectively (USEPA, December 2002) for industrial exposures. The CTDEP (March 2003) and ASTM (2004) default value of 0.83 hr^{-1} was used as the air exchange rate and 300 cm was used as the building height. The same input parameters that were used to evaluate residential exposures were used for the remaining input parameters.

Toxicity criteria for trichloroethene are not currently published on the USEPA's IRIS database or in USEPA's Health Effects Assessment Summary Tables (HEAST). USEPA has published draft toxicity criteria for trichloroethene in the *External Review Draft for Trichloroethylene Health Risk Assessment: Synthesis and Characterization* (2001). The draft toxicity criteria are currently undergoing peer review. Alternatively, the California EPA (CA EPA) has developed toxicity criteria for trichloroethene (2002). Both sets of toxicity criteria were used to estimate risks for exposures to trichloroethene. The draft USEPA guidance recommends values of 1.1×10^{-4} $(ug/m^3)^{-1}$ for the unit risk factor and 0.04 mg/m^3 for the reference concentration. CA EPA recommends values of 2.0×10^{-6} $(ug/m^3)^{-1}$ for the unit risk factor and 0.6 mg/m^3 for the reference concentration. As recommended by USEPA Region I, the unit risk factor for adult exposures of 4.4×10^{-6} $(ug/m^3)^{-1}$ was used for vinyl chloride. The toxicity criteria used in the evaluation are presented in Tables 10 and 11.

The results of the vapor intrusion modeling are summarized in Table 12. Outputs for the Johnson and Ettinger Vapor Intrusion Model are presented in Attachment B.

HIs for residential and industrial exposures to all chemicals at all sites were less than unity (1), indicating that adverse non-carcinogenic effects are not anticipated for these receptors under the defined exposure conditions.

Overall the ILCRs for residential and industrial exposures at all sites were less than or within the USEPA target risk range of 10^{-4} to 10^{-6}. ILCRs for residential and industrial exposures were less than or equal to 1×10^{-6} at Site 2 indicating that there is no significant risk from vapor intrusion at this site.

At Site 3 the ILCR for trichloroethene of 3×10^{-5} for residential exposures and 5×10^{-6} for industrial exposures based on the draft USEPA toxicity criteria exceeds the CTDEP acceptable level for cumulative exposures and the ILCRs of 7×10^{-6} for chloroform and 8×10^{-6} for vinyl chloride exceed the CTDEP acceptable level of 1×10^{-6} for individual chemicals. The ILCR for trichloroethene for residential exposures based on the Cal EPA toxicity and ILCRs for industrial exposures for trichloroethene, chloroform, and vinyl chloride are all less than or equal to 1×10^{-6}. Vinyl chloride was only detected at monitoring well 2DMW29S and trichloroethene and chloroform were not detected in groundwater samples from this monitoring well. Chloroform was detected in groundwater samples from monitoring wells 3MW15I, 3MW15S, 3MW16D, and 3MW16S. The maximum detected concentration of chloroform occurred at monitoring well 3MW16S. Trichloroethene and vinyl chloride were not detected at this monitoring well. Trichloroethene was detected in groundwater samples from monitoring wells 3MW16D and 2MW16D. At monitoring well 3MW16D, the only monitoring well where trichloroethene and chloroform were both detected, the cumulative ILCR for residential exposures is 2×10^{-5} based on the draft USEPA toxicity criteria, and 2×10^{-6} based on the Cal EPA toxicity criteria.

At Site 7 the ILCR for trichloroethene of 2×10^{-6} for residential exposures based on the draft USEPA toxicity criteria is less than the CTDEP acceptable level for cumulative exposures but exceeds the CTDEP acceptable level of 1×10^{-6} for individual chemicals. The ILCR for trichloroethene of 3×10^{-7} for industrial exposures based on draft USEPA toxicity criteria and ILCRs for of 2×10^{-7} and 3×10^{-8} for residential and industrial exposures, respectively, based on the Cal EPA toxicity criteria for trichloroethene are less than the CTDEP acceptable level for individual chemicals. Also the maximum detected concentration of trichloroethene in groundwater samples at Site 7 of 1 µg/L is less than the residential CTDEP RSR of 27 µg/L for vapor intrusion.

At Site 15 the ILCR of 4×10^{-6} for residential exposures is less than the CTDEP acceptable level for cumulative exposures but exceeds the CTDEP acceptable level of 1×10^{-6} for individual chemicals. The ILCR of 5×10^{-7} for industrial exposures is less than the CTDEP acceptable level for individual chemicals.

Also the maximum detected concentration of chloroform in groundwater samples at Site 15 of 3 µg/L is less than the residential CTDEP RSR of 26 µg/L for vapor intrusion.

At Site 20 the ILCR for trichloroethene of 4 x 10^{-6} for residential exposures based on the draft USEPA toxicity criteria is less than the CTDEP acceptable level for cumulative exposures but exceeds the CTDEP acceptable level of 1 x 10^{-6} for individual chemicals. The ILCR for trichloroethene of 6 x 10^{-7} for industrial exposures based on the draft USEPA toxicity criteria is less than the CTDEP acceptable level of 1 x 10^{-6} for individual chemicals. ILCRs for of 7 x 10^{-8} and 1 x 10^{-8} for residential and industrial exposures, respectively, based on the Cal EPA toxicity criteria for trichloroethene are less than the CTDEP acceptable level for individual chemicals. Also the maximum detected concentration of trichloroethene in groundwater samples at Site 20 of 5.02 µg/L is less than the residential CTDEP RSR of 27 µg/L for vapor intrusion.

At Site 23 for residential exposures the ILCR for chloroform of 2 x 10^{-6} and trichloroethene of 4 x 10^{-6} based on the draft USEPA toxicity criteria are less than the CTDEP acceptable level for cumulative exposures but exceeds the CTDEP acceptable level of 1 x 10^{-6} for individual chemicals. The ILCR for trichloroethene for residential exposures based on the Cal EPA toxicity and ILCRs for industrial exposures for trichloroethene and vinyl chloride are all less than 1 x 10^{-6}. Also the maximum detected concentration of chloroform in groundwater samples at Site 23 of 3 µg/L is less than the residential CTDEP RSR of 26 µg/L for vapor intrusion.

Preliminary Remediation Goals

The vapor intrusion model was also used to calculate site-specific, risk-based preliminary remediation goals (PRGs) for vapor intrusion at all the sites. The PRGs are presented in Table 13 and are based on a 1 x 10^{-6} risk level or a hazard index of 1. The model outputs for the PRGs are included in Attachment B. As recommended by USEPA Region I (April 2008), the PRGs for trichloroethene are based on the Cal EPA toxicity criteria. Also included in Table 13 are USEPA maximum contaminant levels (MCLs) and CTDEP RSRs. These criteria would be considered applicable or relevant and appropriate requirements (ARARs).

The CTDEP RSRs for vapor intrusion were also derived using the Johnson and Ettinger model, although CTDEP uses different input parameters than those recommended by USEPA. The most notable difference is that the CTDEP RSRs for trichloroethene are not risk-based but based on a background air concentration of 1 ug/m^3.

Uncertainty Analysis

The results of the vapor intrusion modeling are subject to the following sources of uncertainty:

- The model assumes an infinite source. The sources of VOCs at the sites have been removed and VOCs are no longer being released to groundwater. In addition, concentrations of VOCs in groundwater are decreasing with time.

- The model assumes that the areal extent of contamination is greater than that of the building floor in contact with the soil and that the contamination is homogeneously distributed within the zone of contamination. The groundwater concentrations from a single well were used as the exposure point concentrations for the model. It is not known if the extent of the groundwater plume is larger or smaller than the assumed building foot print.

- The model assumes that the contaminant exposure point concentration is present in groundwater at the soil/groundwater interface. The model does not consider the case when contaminated groundwater is present at depth and a relatively clean layer of groundwater is present at the aquifer surface. In this case, the clean layer of surficial groundwater may slow or restrict the migration of VOC vapors to the unsaturated zone. Modeling was done for several contaminants that were only detected in deep monitoring wells. It was conservatively assumed that these contaminants were present at the same concentrations at the soil/groundwater interface.

- The model does not take into account transformation processes.

- The default building area of 10 meters (32.8 feet) by 10 meters for residential exposures is based on a Michigan study and corresponds to the 10th percentile floor space area for residential single family dwellings. The slab on grade scenario assumes a single floor dwelling 2.44 meters (8 feet) high for residential exposures and 3.0 meters (10 feet) for industrial exposures. The modeling results may be different for a building with different dimensions.

- As discussed above, at present there are no USEPA-approved toxicity criteria for trichloroethene. Risks were calculated in this evaluation using draft toxicity criteria published by USEPA (2001) and toxicity criteria developed by Cal EPA (2002). At the Association of State and Territorial Solid Waste Management Officials (ASTSWMO) meeting in San Diego, California on March 13, 2008, Mary T. Cooke of the USEPA's Federal Facilities Restoration and Reuse Office (FFRRO) announced USEPA provisional guidance for trichloroethene. The provisional guidance is based on the Cal EPA toxicity criteria. According to Cooke's presentation, USEPA is recommending that regulators manage risk within a range of 1 to 10 µg/m^3. The provisional guidance has not yet been officially published. USEPA Region I recommended using the Cal EPA toxicity criteria to develop the PRGs in this evaluation. Risks from trichloroethene that were estimated in this evaluation using the Cal EPA toxicity criteria were within USEPA and CTDEP acceptable levels for both residential and industrial exposures.

SUMMARY AND CONCLUSIONS

Site 2

Concentrations of chloroform, tetrachloroethene, and trichloroethene exceeded the USEPA screening criterion at Site 2. These chemicals were further evaluated using the Johnson and Ettinger Vapor Intrusion Model. Modeling results showed that cancer risks and hazard indices for residential and industrial scenarios were within USEPA and CTDEP acceptable levels at Site 2. Further evaluation against PRGs and ARARs showed that vapor intrusion is not an issue at Site 2. No further action is required for vapor intrusion issues.

Site 3

Concentrations of chloroform, trichloroethene, and vinyl chloride exceeded USEPA screening criterion at Site 3. Concentrations of vinyl chloride also exceed the residential CTDEP RSR for vapor intrusion at Site 3. These chemicals were further evaluated using the Johnson and Ettinger Vapor Intrusion Model. Modeling results showed that cancer risks and hazard indices for residential and industrial scenarios were within USEPA acceptable levels. Cancer risks for chloroform and vinyl chloride for residential exposures exceeded the CTDEP acceptable risk levels. Cancer risks for trichloroethene based upon Cal EPA toxicity criteria were within CTDEP acceptable levels for residential and industrial scenarios but cancer risks based upon draft EPA toxicity criteria exceeded CTDEP acceptable levels.

The maximum detected concentration of chloroform exceeds the site-specific PRG for residential exposures but is less than the site-specific PRG for industrial exposures, USEPA MCL, and the CTDEP RSRs for vapor intrusion for chloroform. Because the modeling only showed potential cancer risks exceeding CTDEP acceptable levels and the maximum concentration did not exceed the CTDEP RSRs for vapor intrusion, it is concluded that there are no vapor intrusion issues associated with chloroform and no further action is required.

The maximum detected concentration of trichloroethene exceeds the USEPA MCL but is less than the site-specific PRGs and CTDEP RSRs for vapor intrusion. A groundwater monitoring program and land use controls are in place to address the exceedance of the USEPA MCL for trichloroethene. No further action is required for vapor intrusion issues.

The maximum detected concentration of vinyl chloride exceeds the USEPA MCL, site-specific PRGs, and residential CTDEP RSR for vapor intrusion. A groundwater monitoring program and land use controls are in place to address the exceedance of the USEPA MCL for vinyl chloride. Considering the CTDEP RSRs for vapor intrusion, the vinyl chloride concentration detected in groundwater at monitoring well 2DMW29S does not represent a vapor intrusion issue under the current industrial scenario, but may be an issue under a future residential scenario. A building could be constructed in the vicinity of monitoring well 2DMW29S for industrial purposes; however, there would be restrictions on construction of a building within 100 feet of the well for residential use unless steps were taken to mitigate the vapor intrusion issue. The current Site 3 land use control document should be amended to include controls to address vapor intrusion issues at well 2DMW29S until groundwater concentrations are reduced to levels where vapor intrusion is no longer deemed an issue.

Site 7

Concentrations of trichloroethene exceeded the USEPA screening criterion at Site 7. Trichloroethene was further evaluated using the Johnson and Ettinger Vapor Intrusion Model. Modeling results showed that cancer risks and hazard indices for residential and industrial scenarios were within USEPA acceptable levels. Cancer risks based upon Cal EPA toxicity criteria were within CTDEP acceptable levels for residential but cancer risks based upon draft USEPA toxicity criteria exceeded CTDEP acceptable levels. Further evaluation against PRGs and ARARs showed that vapor intrusion is not an issue at Site 7. No further action is required for vapor intrusion issues.

Site 15

Concentrations of chloroform in one sample exceeded the USEPA screening criterion at Site 15. Chloroform was further evaluated using the Johnson and Ettinger Vapor Intrusion Model. Modeling results showed that cancer risks under a residential scenario were within USEPA acceptable levels but exceeded CTDEP acceptable levels. Cancer risks for an industrial scenario were within USEPA and CTDEP acceptable levels. Further evaluation against ARARs showed that vapor intrusion is not an issue at Site 15. No further action is required for vapor intrusion issues.

Site 20

Concentrations of trichloroethene exceeded the USEPA screening criterion at Site 20. Trichloroethene was further evaluated using the Johnson and Ettinger Vapor Intrusion Model. Modeling results showed that cancer risks based upon Cal EPA toxicity criteria were within USEPA and CTDEP acceptable levels for residential and industrial scenarios but cancer risks for a residential scenario based upon draft USEPA toxicity criteria exceeded CTDEP acceptable levels. Further evaluation against PRGs and ARARs showed that vapor intrusion is not an issue at Site 20. No further action is required for vapor intrusion issues.

Site 23

Concentrations of chloroform and trichloroethene exceeded the USEPA screening criterion at Site 23. Chloroform and trichloroethene were further evaluated using the Johnson and Ettinger Vapor Intrusion Model. Modeling results showed that cancer risks for chloroform under a residential scenario were within USEPA acceptable levels but exceeded CTDEP acceptable levels. Cancer risks for trichloroethene based upon Cal EPA toxicity criteria were within USEPA and CTDEP acceptable levels for residential and industrial scenarios but cancer risks for a residential scenario based upon draft USEPA toxicity criteria exceeded CTDEP acceptable levels. Further evaluation against ARARs showed that vapor intrusion is not an issue at Site 23. No further action is required for vapor intrusion issues.

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TABLE 1
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN AT SITE 2 - UPGRADIENT MONITORING WELLS
VAPOR INTRUSION
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Upgradient Monitoring Wells (Site 2)

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	USEPA Groundwater Volatilization Criteria(5)	CTDEP Groundwater Volatilization Criteria(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
Volatile Organic Compounds															
75-35-4	1,1-Dichloroethene	1	J	1	J	ug/L	2LGW20S-03	1/18	1	1	NA	190 N	190	No	BSL
67-64-1	Acetone	10	J	10	J	ug/L	4GW01S-10	1/15	5	10	NA	220000 N	50000	No	BSL
75-15-0	Carbon Disulfide	0.9	J	2		ug/L	4GW01S-10	1/18	1 - 2	2	NA	560 N	NA	No	BSL
67-66-3	Chloroform	1		1		ug/L	4GW01S-02	1/18	1 - 3	1	NA	0.71 C(8)	26	Yes	ASL
74-87-3	Chloromethane	0.6	J	0.6	J	ug/L	4GW01S-09	1/18	1	0.6	NA	6.7 C	390	No	BSL
127-18-4	Tetrachloroethene	0.11	J	0.11	J	ug/L	4GW01S-05	1/18	1	0.11	NA	0.55 C	340	No	BSL
79-01-6	Trichloroethene	0.9	J	0.9	J	ug/L	4GW01S-08-D	1/18	1	0.9	NA	0.05 C(8)	27	Yes	ASL

Notes:
Data is from the Year 3 Annual Groundwater Monitoring Report for Area A Landfill (Tetra Tech, 2003).
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background data is available for VOCs.
5 - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. November 2002. EPA530-F-02-052.
Values are from Table 2c and correspond to a target cancer risk level of 1E-6 or HI =1 and an attenuation factor of 0.001.
6 - Connecticut's Proposed Revisions Remediation Standard Regulations, Volatilization Criteria, Residential, March 2003.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
8 - USEPA Region I target level.
A shaded value indicates that the concentration used for screening exceeds the criterion or background value.
A shaded chemical name indicates that the chemical has been selected as a COPC .

Associated Samples

2LGW20S-01	2LGW20S-11	4GW01S-07-D
2LGW20S-02	4GW01S-01	4GW01S-08
2LGW20S-02-D	4GW01S-01-D	4GW01S-08-D
2LGW20S-03	4GW01S-02	4GW01S-09
2LGW20S-04	4GW01S-03	4GW01S-09-D
2LGW20S-05	4GW01S-04	4GW01S-10
2LGW20S-06	4GW01S-05	4GW01S-10-D
2LGW20S-07	4GW01S-06	4GW01S-11
2LGW20S-08	4GW01S-06-D	4GW01S-11-D
2LGW20S-10	4GW01S-07	

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered.
C = Carcinogen.
COPC = Chemical of Potential Concern.
J = Estimated Value.
N = Noncarcinogen.
NA = Not Applicable.
MCL = Federal Maximum Contaminant Level

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC Screening Level/ARAR/TBC.

For Elimination as a COPC:
BSL = Below COPC Screening Level/ARAR/TBC.

TABLE 2
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN AT SITE 2 - DOWNGRADIENT MONITORING WELLS IN AREA A DOWNSTREAM
VAPOR INTRUSION
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Downgradient Monitoring Wells In Area A Downstream (Site 2)

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	USEPA Groundwater Volatilization Criteria(5)	CTDEP Groundwater Volatilization Criteria(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
Volatile Organic Compounds															
75-15-0	Carbon Disulfide	0.2	J	2.2		ug/L	3GW37S-08	2/17	1	2.2	NA	560 N	NA	No	BSL
156-59-2	cis-1,2-Dichloroethene	0.14	J	0.4	J	ug/L	3GW37S-03	5/17	1	0.4	NA	210 N	830	No	BSL
108-88-3	Toluene	0.1	J	0.1	J	ug/L	3GW37S-03	1/17	1	0.1	NA	1500 N	7100	No	BSL
156-60-5	trans-1,2-Dichloroethene	0.2	J	0.2	J	ug/L	3GW37S-03	1/17	1	0.2	NA	180 N	1000	No	BSL
79-01-6	Trichloroethene	0.58	J	2		ug/L	3GW37S-03	9/17	1	2	NA	0.05 C(8)	27	Yes	ASL

Notes:
Data is from the Year 3 Annual Groundwater Monitoring Report for Area A Landfill (Tetra Tech, 2003).
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background data is available for VOCs.
5 - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. November 2002. EPA530-F-02-052.
Values are from Table 2c and correspond to a target cancer risk level of 1E-6 or HI =1 and an attenuation factor of 0.001.
6 - Connecticut's Proposed Revisions Remediation Standard Regulations, Volatilization Criteria, Residential, March 2003.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
8 - USEPA Region I target level.
A shaded value indicates that the concentration used for screening exceeds the criterion or background value.
A shaded chemical name indicates that the chemical has been selected as a COPC .

Associated Samples

3GW-12D-01	3GW-12S-01	3GW37S-02	3GW37S-08
3GW-12D-01-D	3GW-12S-02	3GW37S-03	3GW37S-09
3GW-12D-02	3GW-12S-02-D	3GW37S-04	3GW37S-10
3GW-12D-03	3GW-12S-03	3GW37S-05	3GW37S-11
3GW-12D-03-3D	3GW-12S-03-D	3GW37S-06	3GW12D-11
3GW-12D-04	3GW37S-01	3GW37S-07	

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered.
C = Carcinogen.
COPC = Chemical of Potential Concern.
J = Estimated Value.
N = Noncarcinogen.
NA = Not Applicable.
MCL = Federal Maximum Contaminant Level

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC Screening Level/ARAR/TBC.

For Elimination as a COPC:
BSL = Below COPC Screening Level/ARAR/TBC.

TABLE 3
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN AT SITE 2 - DOWNGRADIENT MONITORING WELLS IN AREA A WETLAND
VAPOR INTRUSION
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Downgradient Monitoring Wells In Area A Wetland (Site 2)

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	USEPA Groundwater Volatilization Criteria(5)	CTDEP Groundwater Volatilization Criteria(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
Volatile Organic Compounds															
78-93-3	2-Butanone	1	J	26		ug/L	2WGW39DS-04	20/61	1 - 25	26	NA	440000 N	NA	No	BSL
67-64-1	Acetone	2	J	120		ug/L	2WGW39DS-04	26/79	5 - 31	120	NA	220000 N	50000	No	BSL
71-43-2	Benzene	0.2	J	0.3	J	ug/L	2WGW42DS-10	2/99	1 - 5	0.3	NA	1.36 C	130	No	BSL
75-15-0	Carbon Disulfide	0.2	J	7.6		ug/L	2WGW43DS-07	58/99	1 - 13	7.6	NA	560 N	NA	No	BSL
74-87-3	Chloromethane	0.8	J	0.8	J	ug/L	2WGW44DS-09	1/99	1 - 5	0.8	NA	6.7 C	390	No	BSL
100-41-4	Ethylbenzene	0.3	J	0.3	J	ug/L	2WGW39DS-04	1/99	1 - 5	0.3	NA	6.91 N(8)	2700	No	BSL
75-09-2	Methylene Chloride	0.5	J	1.2	J	ug/L	2WGW39DS-07	6/99	1 - 10	1.2	NA	58 C	160	No	BSL
127-18-4	Tetrachloroethene	0.3	J	1.4		ug/L	2WGW39DS-07	2/99	1 - 5	1.4	NA	0.55 C(8)	340	Yes	ASL
108-88-3	Toluene	0.17	J	4		ug/L	2WGW39DS-03, 2WGW39DS-09	17/99	1 - 5	4	NA	1500 N	7100	No	BSL
1330-20-7	Total Xylenes	0.6	J	0.6	J	ug/L	2WGW42DS-09	1/89	1 - 5	0.6	NA	22000 N	8700	No	BSL
79-01-6	Trichloroethene	1.2		1.4		ug/L	2WGW46DS-07	2/99	1 - 5	1.4	NA	0.05 C(8)	27	Yes	ASL

Notes:
Data is from the Year 3 Annual Groundwater Monitoring Report for Area A Landfill (Tetra Tech, 2003).
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background data is available for VOCs.
5 - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. November 2002. EPA530-F-02-052.
Values are from Table 2c and correspond to a target cancer risk level of 1E-6 or HI =1 and an attenuation factor of 0.001.
6 - Connecticut's Proposed Revisions Remediation Standard Regulations, Volatilization Criteria, Residential, March 2003.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
8 - USEPA Region I target level.
A shaded value indicates that the concentration used for screening exceeds the criterion or background value.
A shaded chemical name indicates that the chemical has been selected as a COPC .

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered.
C = Carcinogen.
COPC = Chemical of Potential Concern.
J = Estimated Value.
N = Noncarcinogen.
NA = Not Applicable.
MCL = Federal Maximum Contaminant Level

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC Screening Level/ARAR/TBC.

For Elimination as a COPC:

TABLE 4
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN AT SITE 3
VAPOR INTRUSION
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Site 3

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	USEPA Groundwater Volatilization Criteria(5)	CTDEP Groundwater Volatilization Criteria(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
Volatile Organic Compounds															
79-34-5	1,1,2,2-Tetrachloroethane	0.33	J	0.33	J	ug/L	S3GW2DMW16D01	1/36	0.5 - 1	0.33	NA	3 C	1.8	No	BSL
75-27-4	Bromodichloromethane	0.5	J	1.8		ug/L	S3GW3MW16D01	4/36	0.5 - 1	1.8	NA	2.1 C	NA	No	BSL
124-48-1	Chlorodibromomethane	0.76		0.76		ug/L	S3GW3MW16D01	1/36	0.5 - 1	0.76	NA	3.2 C	NA	No	BSL
67-66-3	Chloroform	0.6	J	15		ug/L	S3GW3MW16S01	11/36	0.5 - 7.3	15	NA	0.71 C(8)	26	Yes	ASL
156-59-2	cis-1,2-Dichloroethene	2		6		ug/L	S3GW2DMW29S02, S3GW2DMW29S02-D	11/36	0.5 - 1	6	NA	210 N	830	No	BSL
127-18-4	Tetrachloroethene	0.33	J	0.33	J	ug/L	S3GW3MW16S01	1/36	0.5 - 1	0.33	NA	0.55 C(8)	340	No	BSL
108-88-3	Toluene	0.33	J	51		ug/L	S3GW2DMW28D02	4/36	0.5 - 1	51	NA	1500 N	7100	No	BSL
1330-20-7	Total Xylenes	0.6	J	0.6	J	ug/L	S3GW2DMW28D02, S3GW2DMW28D03	2/36	0.5 - 1	0.6	NA	22000 N	8700	No	BSL
156-60-5	trans-1,2-Dichloroethene	0.33	J	0.5	J	ug/L	S3GW2DMW16S04	2/36	0.5 - 1	0.5	NA	180 N	1000	No	BSL
79-01-6	Trichloroethene	2		7		ug/L	S3GW2DMW16D02, S3GW2DMW16D03, S3GW2DMW16S04	8/36	0.5 - 1	7	NA	0.05 C(8)	27	Yes	ASL
75-01-4	Vinyl Chloride	1.7		10		ug/L	S3GW2DMW29S02-D	3/36	0.5 - 1	10	NA	0.5 C(8)	1.6	Yes	ASL

Notes:
Data is from the Year 1 Annual Groundwater Monitoring Report for Sites 3 and 7 (Tetra Tech, 2007).
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background data is available for VOCs.
5 - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. November 2002. EPA530-F-02-052.
Values are from Table 2c and correspond to a target cancer risk level of 1E-6 or HI =1 and an attenuation factor of 0.001.
6 - Connecticut's Proposed Revisions Remediation Standard Regulations, Volatilization Criteria, Residential, March 2003.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
8 - USEPA Region I target level.
A shaded value indicates that the concentration used for screening exceeds the criterion or background value.
A shaded chemical name indicates that the chemical has been selected as a COPC .

Associated Samples

S3GW2DMW16D01
S3GW2DMW16D02
S3GW2DMW16D03
S3GW2DMW16D04
S3GW2DMW16S01
S3GW2DMW16S02
S3GW2DMW16S03
S3GW2DMW16S04
S3GW2DMW25S01
S3GW2DMW25S02
S3GW2DMW25S03
S3GW2DMW25S04
S3GW2MW28D01
S3GW2DMW28D02
S3GW2DMW28D03
S3GW2DMW28D04
S3GW2DMW29S01
S3GW2DMW29S02
S3GW2DMW29S03
S3GW2DMW29S04
S3GW3MW15I01
S3GW3MW15I02
S3GW3MW15I03
S3GW3MW15I04
S3GW3MW15S01
S3GW3MW15S02
S3GW3MW15S03
S3GW3MW15S04
S3GW3MW16D01
S3GW3MW16D02
S3GW3MW16D03
S3GW3MW16D04
S3GW3MW16S01
S3GW3MW16S02
S3GW3MW16S03
S3GW3MW16S04

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered.
C = Carcinogen.
COPC = Chemical of Potential Concern.
J = Estimated Value.
N = Noncarcinogen.
NA = Not Applicable.
MCL = Federal Maximum Contaminant Level

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC Screening Level/ARAR/TBC.

For Elimination as a COPC:
BSL = Below COPC Screening Level/ARAR/TBC.

TABLE 5
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN AT SITE 7
VAPOR INTRUSION
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Site 7

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	USEPA Groundwater Volatilization Criteria(5)	CTDEP Groundwater Volatilization Criteria(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
Volatile Organic Compounds															
76-13-1	1,1,2-Trichlorotrifluoroethane	0.58		0.58		ug/L	S7GW7MW12I01	1/7	0.5	0.58	NA	1500 N	NA	No	BSL
75-34-3	1,1-Dichloroethane	0.32	J	0.77		ug/L	S7GW7MW12I01	5/28	0.5 - 1	0.77	NA	2200 N	3000	No	BSL
108-90-7	Chlorobenzene	1	J	2		ug/L	S7GW7MW12S03, S7GW7MW12S04	4/28	0.5 - 1	2	NA	390 N	1800	No	BSL
156-59-2	cis-1,2-Dichloroethene	0.32	J	0.6	J	ug/L	S7GW7MW12S03, S7GW7MW12I01	3/28	0.5 - 1	0.6	NA	210 N	830	No	BSL
156-60-5	trans-1,2-Dichloroethene	1	J	1	J	ug/L	S7GW7MW12I03	1/28	0.5 - 1	1	NA	180 N	1000	No	BSL
79-01-6	Trichloroethene	0.7	J	1		ug/L	S7GW7MW5D02, S7GW7MW5D03, S7GW7MW12I03	8/28	0.5 - 1	1	NA	0.05 C(8)	27	Yes	ASL

Notes:
Data is from the Year 1 Annual Groundwater Monitoring Report for Sites 3 and 7 (Tetra Tech, 2007).
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background data is available for VOCs.
5 - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. November 2002. EPA530-F-02-052.
Values are from Table 2c and correspond to a target cancer risk level of 1E-6 or HI =1 and an attenuation factor of 0.001.
6 - Connecticut's Proposed Revisions Remediation Standard Regulations, Volatilization Criteria, Residential, March 2003.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
8 - USEPA Region I target level.
A shaded value indicates that the concentration used for screening exceeds the criterion or background value.
A shaded chemical name indicates that the chemical has been selected as a COPC.

Associated Samples

S7GW7MW1D01	S7GW7MW5D03
S7GW7MW1D02	S7GW7MW5D04
S7GW7MW1D03	S7GW7MW9S01
S7GW7MW1D04	S7GW7MW9S02
S7GW7MW3I01	S7GW7MW9S03
S7GW7MW3I02	S7GW7MW9S04
S7GW7MW3I03	S7GW7MW12I01
S7GW7MW3I04	S7GW7MW12I02
S7GW7MW3S01	S7GW7MW12I03
S7GW7MW3S02	S7GW7MW12I04
S7GW7MW3S03	S7GW7MW12S01
S7GW7MW3S04	S7GW7MW12S02
S7GW7MW5D01	S7GW7MW12S03
S7GW7MW5D02	S7GW7MW12S04

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered.
C = Carcinogen.
COPC = Chemical of Potential Concern.
J = Estimated Value.
N = Noncarcinogen.
NA = Not Applicable.
MCL = Federal Maximum Contaminant Level

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC Screening Level/ARAR/TBC.

For Elimination as a COPC:
BSL = Below COPC Screening Level/ARAR/TBC.

TABLE 6
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN AT SITE 15
VAPOR INTRUSION
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Site 15

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Nondetects[2]	Concentration Used for Screening[3]	Background Value[4]	USEPA Groundwater Volatilization Criteria(5)	CTDEP Groundwater Volatilization Criteria(6)	COPC Flag	Rationale for Contaminant Deletion or Selection[7]
Volatile Organic Compounds															
67-66-3	Chloroform	3		3		UG/L	S15GW15TW301	1/6	1	3	N/A	0.71 N[8]	26	Yes	ASL

Notes:
Data is from the Basewide Groundwater Operable Unit Remedial Investigation Report Update/Feasibility Study Report (Tetra Tech, 2004).
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background data is available for VOCs.
5 - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. November 2002. EPA530-F-02-052.
Values are from Table 2c and correspond to a target cancer risk level of 1E-6 or HI =1 and an attenuation factor of 0.001.
6 - Connecticut's Proposed Revisions Remediation Standard Regulations, Volatilization Criteria, March 2003.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
8 - USEPA Region I target level.
A shaded value indicates that the concentration used for screening exceeds the criterion or background value.
A shaded chemical name indicates that the chemical has been selected as a COPC .

Associated Samples:
S15GW15MW1S02
S15GW15MW2S02
S15GW15MW2S02-D
S15GW15MW3S02
S15GW15TW101
S15GW15TW201
S15GW15TW301

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered.
C = Carcinogen.
COPC = Chemical of Potential Concern.
J = Estimated Value.
N = Noncarcinogen.
NA = Not Applicable.
MCL = Federal Maximum Contaminant Level

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC Screening Level/ARAR/TBC.

For Elimination as a COPC:
BSL = Below COPC Screening Level/ARAR/TBC.

TABLE 7
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN AT SITE 20
VAPOR INTRUSION
NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Area A Weapons Center (Site 20)

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	USEPA Groundwater Volatilization Criteria(5)	CTDEP Groundwater Volatilization Criteria(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
Volatile Organic Compounds															
108-10-1	4-Methyl-2-Pentanone	1.29	J	1.29	J	ug/L	S202WCMW2S01	1/4	5	1.29	N/A	14000 N	13000	No	NTX
79-01-6	Trichloroethene	3.8	J	5.02	J	ug/L	S202WCMW2S01	2/4	1	5.02	N/A	0.05 C[8]	27	Yes	ASL

Notes:
Data is from the Basewide Groundwater Operable Unit Remedial Investigation Report (Tetra Tech, 2001).
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background data is available for VOCs.
5 - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. November 2002. EPA530-F-02-052.
Values are from Table 2c and correspond to a target cancer risk level of 1E-6 or HI =1 and an attenuation factor of 0.001.
6 - Connecticut's Proposed Revisions Remediation Standard Regulations, Volatilization Criteria, March 2003.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
8 - USEPA Region I target level.
A shaded value indicates that the concentration used for screening exceeds the criterion or background value.
A shaded chemical name indicates that the chemical has been selected as a COPC .

Associated Samples:
S202WCMW1S01
S202WCMW2S01
S202WCMW3S01
S202WMW4D01

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered.
C = Carcinogen.
COPC = Chemical of Potential Concern.
J = Estimated Value.
N = Noncarcinogen.
NA = Not Applicable.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC Screening Level/ARAR/TBC.

For Elimination as a COPC:
BSL = Below COPC Screening Level/ARAR/TBC.
NTX = No Toxicity Information.

TABLE 8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN AT SITE 23 - UNDERDRAIN METERING PIT

VAPOR INTRUSION

NSB-NLON, GROTON, CONNECTICUT

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Underdrain Metering Pit (Site 23)

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	USEPA Groundwater Volatilization Criteria(5)	CTDEP Groundwater Volatilization Criteria(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
Volatile Organic Compounds															
71-43-2	Benzene	0.2	J	0.2	J	ug/L	S23GWMPM04	1/4	0.5	0.2	NA	1.4 C(8)	130	No	BSL
75-27-4	Bromodichloromethane	0.3	J	0.3	J	ug/L	S23GWMPM01	1/4	0.5	0.3	NA	2.1 C	2.3	No	BSL
110-82-7	Cyclohexane	0.1	J	0.1	J	ug/L	S23GWMPM02	1/4	0.5	0.1	NA	NA	NA	No	NTX
67-66-3	Chloroform	2	J	3	J	ug/L	S23GWMPM01	1/4	0.5	3	NA	0.71 C(8)	26	Yes	ASL
156-59-2	cis-1,2-Dichloroethene	0.2	J	0.3	J	ug/L	S23GWMPM01, S23GWMPM02	4/4	0.5	0.3	NA	210 N	830	No	BSL
98-82-8	Isopropylbenzene	0.09	J	0.1	J	ug/L	S23GWMPM01, S23GWMPM02	2/4	0.5	0.1	NA	8.4 N	NA	No	BSL
1634-04-4	Methyl Tert-Butyl Ether	0.4	J	1		ug/L	S23GWMPM01	4/4	--	1	NA	120000 N	21000	No	BSL
127-18-4	Tetrachloroethene	0.2	J	0.4	J	ug/L	S23GWMPM02	4/4	--	0.4	NA	0.55 C(8)	340	No	BSL
79-01-6	Trichloroethene	0.3	J	0.5	J	ug/L	S23GWMPM02	4/4	--	0.5	NA	0.05 C(8)	27	Yes	ASL

Notes:

Data is from the Year 1 Annual Monitoring Report for Site 23 Underdrain Metering Pit (Tetra Tech, 2008).

1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.

2 - Values presented are sample-specific quantitation limits.

3 - The maximum detected concentration is used for screening purposes.

4 - No background data is available for VOCs.

5 - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. November 2002. EPA530-F-02-052.
Values are from Table 2c and correspond to a target cancer risk level of 1E-6 or HI =1 and an attenuation factor of 0.001.

6 - Connecticut's Proposed Revisions Remediation Standard Regulations, Volatilization Criteria, Residential, March 2003.

7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).

8 - USEPA Region I target level.

A shaded value indicates that the concentration used for screening exceeds the criterion or background value.

A shaded chemical name indicates that the chemical has been selected as a COPC .

Associated Samples

S23GWMPM01
S23GWMPM01-D
S23GWMPM02
S23GWMPM-03
S23GWMPM02-D
S23GWMPM04

Definitions:

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered.
C = Carcinogen.
COPC = Chemical of Potential Concern.
J = Estimated Value.
N = Noncarcinogen.
NA = Not Applicable.
MCL = Federal Maximum Contaminant Level

Rationale Codes:

For Selection as a COPC:
ASL = Above COPC Screening Level/ARAR/TBC.

For Elimination as a COPC:
BSL = Below COPC Screening Level/ARAR/TBC.
NTX = No toxicity criteria available.

TABLE 9
INPUT PARAMETERS FOR THE VAPOR INTRUSION MODEL
NSB-NLON, GROTON, CONNECTICUT

Site and Well	Depth to Groundwater (feet bgs)	Depth to Groundwater Used in Model	Soil Type	Soil Type Used in Model	Dry Bulk Density (gm/cm^3)	Total Porosity	Screened Interval (feet bgs)	Reference
2								
Upgradient								
4MW01S	6.3 to 9.9	6.3 feet (190 cm)	Bedrock w/ gravel and silty sand above	Sandy Loam (SL)	1.8	0.33	8 to 18	Year 3 GMR for Area A Landfill, Rounds 9 through 11, 12/2002 to 9/2002
Downstream								
3MW37S	3.61 to 3.79	3.6 feet (110 cm)	Silty Sand w/ trace rock fragments	Sandy Loam (SL)	1.8	0.33	4.5 to 5.5	Year 3 GMR for Area A Landfill, Rounds 9 through 11, 12/2002 to 9/2002
Wetlands								
2WMW39DS	2.4 to 3.4	2.1 feet (65 cm)	Org. Clayey Silt	Clay Loam (CL)	Default	Default	4 to 14	Year 3 GMR for Area A Landfill, Rounds 9 through 11, 12/2002 to 9/2002
2WMW46DS	1.55 to 2.28		Org. Clayey Silt		Default	Default	4 to 14	Year 3 GMR for Area A Landfill, Rounds 9 through 11, 12/2002 to 9/2002
3								
3MW15I	30.9	3.6 feet (110 cm)	Sand and Gravel	Sand (S)	1.8	0.33	55 to 65	Rnd 4, Year 1 GMR for Sites 3 and 7
3MW15S	29.4		Sand and Gravel		1.8	0.33	28 to 38	Rnd 4, Year 1 GMR for Sites 3 and 7
3MW16D	22.1		Bedrock w/ sand and cobbles above		1.8	0.33	59 to 69	Rnd 4, Year 1 GMR for Sites 3 and 7
3MW16S	14.4		Bedrock w/ sand and cobbles above		1.8	0.33	17 to 27	Rnd 4, Year 1 GMR for Sites 3 and 7
2DMW16D	3.7		Bedrock w/ sand, silt, and cobbles above		1.8	0.33	18 to 60	Rnd 4, Year 1 GMR for Sites 3 and 7
2DMW29S	8.6		Sand		1.8	0.33	6 to 16	Rnd 4, Year 1 GMR for Sites 3 and 7
7								
7MW05D	12.4	5 feet (150 cm)	Bedrock w/ silty sand w/ trace gravel above	Loamy Sand (LS)	1.6	0.37	32 to 42	Rnd 4, Year 1 GMR for Sites 3 and 7
7MW12I	5		Sandy silt		1.6	0.37	20 to 30	Rnd 4, Year 1 GMR for Sites 3 and 7
15								
15TW03	6.5	6.5 feet (200 cm)	Sandy silt	Loamy Sand (LS)	1.5	0.45	5 to 15	BGOURI Update/FS
20								
2WCMW2S	4.6	4.6 feet (140 cm)	Silty sand w/ granite fragments	Sandy Loam (SL)	1.6	0.37	4 to 14	BGOURI Update/FS
2WCMW4D	6.1		Bedrock		1.6	0.37	13 to 119	BGOURI Update/FS
23								
23MP01	7 to 9	7 feet (210 cm)	Silty sand	Sandy Loam (SL)	1.5	0.45	HNUS 23 (7 to 17)	BGOURI

Other Information

Site	Bulk Density (lb/cf)	Bulk Density (g/cm^3)	Porosity	Reference
3	112.22	1.8	0.3306	BGOURI
7	98.77	1.6	0.374	BGOURI
23	90.8	1.5	0.445	BGOURI

TABLE 10
NON-CANCER TOXICITY DATA -- INHALATION
NSB-NLON, GROTON, CONNECTICUT

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds									
Chloroform	Chronic	4.9E-02	mg/m^3	1.4E-02	(mg/kg/day)	Liver	NA	USEPA III	10/11/2007
Tetrachloroethene	Chronic	2.8E-01	mg/m^3	8.0E-02	(mg/kg/day)	Liver	NA	USEPA III	10/11/2007
Trichloroethene - Draft EPA	Chronic	3.5E-02	mg/m^3	1.0E-02	(mg/kg/day)	Liver, CNS	NA	USEPA(1)	8/2001
Trichloroethene - Cal EPA	Chronic	6.0E-01	mg/m3	1.7E-01	(mg/kg/day)	Liver, CNS	NA	CA EPA	12/2002
Vinyl Chloride	Chronic	1.0E-01	mg/m^3	2.9E-02	(mg/kg/day)	Liver	30/1	IRIS	5/02/2008

Notes:
1 - Extrapolated RfD = RfC $*20m^3$/day / 70 kg

Definitions:
CNS = Central Nervous System
EPA III = U.S. EPA Region 3 RBC Table, October 11, 2007.
IRIS = Integrated Risk Information System
NA = Not available.
USEPA(1) = Draft Trichloroethylene Health Risk Assessment: Synthesis and Characterization, August 2001.
Cal EPA = California EPA, Technical Support Document for Describing Available Cancer Potency Factors, December 2002.

TABLE 11
CANCER TOXICITY DATA -- INHALATION
NSB-NLON, GROTON, CONNECTICUT

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor(1)		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds							
Chloroform	2.3E-05	$(ug/m^3)^{-1}$	8.1E-02	$(mg/kg/day)^{-1}$	B2	IRIS	5/02/2008
Tetrachloroethene	5.9E-06	$(ug/m^3)^{-1}$	2.1E-02	$(mg/kg/day)^{-1}$	NA	USEPA(1)	6/12/2003
Trichloroethene - Draft EPA	1.1E-04	$(ug/m^3)^{-1}$	4.0E-01	$(mg/kg/day)^{-1}$	C	USEPA(2)	8/2001
Trichloroethene - Cal EPA	2.0E-06	(ug/m3)-1	7.0E-03	(mg/kg/day)-1	C	CA EPA	12/2002
Vinyl Chloride (adult)	4.4E-06	$(ug/m^3)^{-1}$	1.5E-02	$(mg/kg/day)^{-1}$	A	IRIS	5/02/2008

Notes:
1 - Inhalation CSF = Unit Risk * 70 kg / 20m^3/day.

Definitions:
IRIS = Integrated Risk Information System.
NA = Not Available.
USEPA(1) = OSWER Directive No.9285.7-75.
USEPA(2) = Draft Trichloroethylene Health Risk Assessment: Synthesis and Characterization, August 2001.

EPA Group:
A - Human carcinogen.
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .
C - Possible human carcinogen.

Chemical	Site 2 - Area A - Upgradient			Site 2 - Area A - Downstream			Site 2 - Area A - Wetlands		
	EPC (ug/L)	Cancer Risk	Hazard Index	EPC (ug/L)	Cancer Risk	Hazard Index	EPC (ug/L)	Cancer Risk	Hazard Index
	Residential			Residential			Residential		
Chloroform	1	5E-08	1E-04	NA	NA	NA	NA	NA	NA
Tetrachloroethene	NA	NA	NA	NA	NA	NA	1.4	8E-08	1E-04
Trichloroethene - EPA Toxicity Criteria	0.9	2E-07	1E-04	2	4E-07	3E-04	1.4	1E-06	6E-04
Trichloroethene - Cal EPA Toxicity Criteria	0.9	3E-09	7E-06	2	8E-09	2E-05	1.4	2E-08	4E-05
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Industrial			Industrial			Industrial		
Chloroform	1	7E-09	2E-05	NA	NA	NA	NA	NA	NA
Tetrachloroethene	NA	NA	NA	NA	NA	NA	1.4	1E-08	2E-05
Trichloroethene - EPA Toxicity Criteria	0.9	2E-08	1E-05	2	6E-08	5E-05	1.4	2E-07	1E-04
Trichloroethene - Cal EPA Toxicity Criteria	0.9	5E-10	1E-06	2	1E-09	3E-06	1.4	3E-09	6E-06
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
NA - Not a COPC at this site.
EPC = Exposure point concentration, maximum detected concentration of a chemical at a site.
Shading indicates an exceedance of USEPA and/or CTDEP acceptable risk levels.

TABLE 12
SUMMARY OF VAPOR INTRUSION MODELING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Chemical	Site 3			Site 7			Site 15		
	EPC (ug/L)	Cancer Risk	Hazard Index	EPC (ug/L)	Cancer Risk	Hazard Index	EPC (ug/L)	Cancer Risk	Hazard Index
	Residential			Residential			Residential		
Chloroform	15	7E-06	1E-02	NA	NA	NA	3	4E-06	7E-03
Tetrachloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene - EPA Toxicity Criteria	7	3E-05	2E-02	1	2E-06	1E-03	NA	NA	NA
Trichloroethene - Cal EPA Toxicity Criteria	7	6E-07	1E-03	1	4E-08	8E-05	NA	NA	NA
Vinyl Chloride	10	8E-06	4E-02	NA	NA	NA	NA	NA	NA
	Industrial			Industrial			Industrial		
Chloroform	15	1E-06	3E-03	NA	NA	NA	3	5E-07	1E-03
Tetrachloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene - EPA Toxicity Criteria	7	5E-06	3E-03	1	3E-07	2E-04	NA	NA	NA
Trichloroethene - Cal EPA Toxicity Criteria	7	8E-08	2E-04	1	6E-09	1E-05	NA	NA	NA
Vinyl Chloride	10	1E-06	7E-03	NA	NA	NA	NA	NA	NA

Notes:
NA - Not a COPC at this site.
EPC = Exposure point concentration, maximum detected concentration of a chemical at a site.
Shading indicates an exceedance of USEPA and/or CTDEP acceptable risk levels.

TABLE 12
SUMMARY OF VAPOR INTRUSION MODELING RESULTS
NSB-NLON, GROTON, CONNECTICUT

Chemical	Site 20			Site 23		
	EPC (ug/L)	Cancer Risk	Hazard Index	EPC (ug/L)	Cancer Risk	Hazard Index
	Residential			Residential		
Chloroform	NA	NA	NA	3	2E-06	5E-03
Tetrachloroethene	NA	NA	NA	NA	NA	NA
Trichloroethene - EPA Toxicity Criteria	5.02	4E-06	2E-03	0.5	4E-06	2E-03
Trichloroethene - Cal EPA Toxicity Criteria	5.02	7E-08	1E-04	0.5	7E-08	1E-04
Vinyl Chloride	NA	NA	NA	NA	NA	NA
	Industrial			Industrial		
Chloroform	NA	NA	NA	3	3E-07	8E-04
Tetrachloroethene	NA	NA	NA	NA	NA	NA
Trichloroethene - EPA Toxicity Criteria	5.02	6E-07	4E-04	0.5	5E-07	4E-04
Trichloroethene - Cal EPA Toxicity Criteria	5.02	1E-08	3E-05	0.5	1E-08	2E-05
Vinyl Chloride	NA	NA	NA	NA	NA	NA

Notes:
NA - Not a COPC at this site.
EPC = Exposure point concentration, maximum detected concentration of a chemical at a site.
Shading indicates an exceedance of USEPA and/or CTDEP acceptable risk levels.

TABLE 13
PRELIMINARY REMEDIATION GOALS AND OTHER ARARs FOR VAPOR INTRUSION
NSB-NLON, GROTON, CONNECTICUT

Chemical	EPC[1] (ug/L)	PRG[2]		USEPA MCL[3]	CTDEP RSR[4]	
		Residential	Industrial		Residential	Industrial
Site 2 - Area A - Upgradient						
Chloroform	1	21	144	80[5]	26	62
Trichloroethene[6]	0.9	258	1769	5	27	67
Site 2 - Area A - Downgradient						
Trichloroethene	2	257	1760	5	27	67
Site 2 - Area A - Wetlands						
Tetrachloroethene	1.4	18	122	5	340	810
Trichloroethene[6]	1.4	74	508	5	27	67
Site 3						
Chloroform	15	2.1	15	80[3]	26	62
Trichloroethene[6]	7	12	85	5	27	67
Vinyl Chloride	10	1.3	8.6	2	1.6	52
Site 7						
Trichloroethene[6]	1	24	163	5	27	67
Site 15						
Chloroform	3	0.9	5.9	80[3]	26	62
Site 20						
Trichloroethene[6]	5.02	68	467	5	27	67
Site 23						
Chloroform	3	1.3	9.1	80[3]	26	62
Trichloroethene[6]	0.5	7.5	52	5	27	67

Acronyms:
ARARs = Applicable or Relevant and Appropriate Regulations
EPC = Exposure Point Concentration.
MCL = Maximum contaminant level.
PRG = Preliminary Remediation Goal
RSR = Remediation Standard Regulations.

Notes:
All concentrations are in ug/L.
1 - EPC is the maximum detected concentration at a site.
2 - PRGs are based on a cancer risk of 1×10^{-6} or an hazard index of 1.
3 - USEPA Drinking Water Standards and Health Advisories, August 2006.
4 - Proposed Revisions - Connecticut's Remediation Standard Regulations, Volatilization Criteria, March 2003.
5 - Value is for total trihalomethanes.
6 - PRG for trichloroethene is calculated using the Cal EPA toxicity criteria.
Shading indicates an exceedance of a PRG or ARAR.

ATTACHMENT A

BORING LOGS AND

DEPTH TO GROUNDWATER INFORMATION

BORING LOG — **HALLIBURTON NUS**

PROJECT: NSB-NLON BORING NO.: 4MW1S
PROJECT NO.: 9594 DATE: 02-03-94 DRILLER: EAST COAST THOMAS / Tim Sabo
ELEVATION: ______ FIELD GEOLOGIST: Tim Evans
WATER LEVEL DATA: ______
(Date, Time & Conditions) ______

	SAMPLE NO. & TYPE OR RQD	DEPTH (Ft.) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth/Ft.)	SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS OVM
	S-1 @ 1438	0.0 / 2.0	15 15 20 15	1.5/2.0		Dense	Black to Gray	Gravel w/Tr Sand	GP	Roadbed Wet 0ppm; Sand - f to c Gr; Gravel - Pebble, Green-Stone
1523	S-2 @ 1452	4.0	13 22 62 100/5	1.1/1.8	BR@2.5	V-Dense	Tan	Clayey Sand w/Tr Gravel / Silty Sand w/Tr Gravel	SC/SW	Wet 0ppm; Sand - f to c Gr; Gravel - Gneiss, Moved 3'; Fe-Stained Gravel - Pebbles
1931 2/3 / 0855 2/4	3.25/5.0	①	65%	4.5/5.0		Hard	Gray to Pink	Gneiss; Hi ∠ JNT @ 2.5' 2.8'; w/ sand seams in jnts 3.3' 5.2	BR	SS Refusal. Move 1' SW.; Lo ∠ Frac @ 5.0' 7.0' 5.5'
0850	7.0									
	.75/1.5	②		1.4/1.5		Hard	Gray to Cream	Gneiss w/sand seams	Br	Lo ∠ Frac @ 7.2', 8.0'; Hi ∠ JNT 7.5', 7.6'
1030 / 1320	8.5									Lo ∠ Frac @ 12.4', 9.9' 11.5'; Core Barrel Break @ 8.6', 8.75', 9.11' 10.9', 13.3'
	4.0/5.0	③	80%	5.0/5.0		Hard	Gray to Pink	Gneiss	VBr Br	
1610 2/4 / 0651 2/7	13.5								M	Pump H_2O out to 13.5' 2/4; Recharge to 6' w/in 30"; H_2O level @ 2.1' 2/7
	3.9/5.0	④	78%	4.8/5.0		Hard	Gray to White	Gneiss	VBR Br	Lo ∠ Frac @ 15.1' 15.2' 15.5' 16.0' 16.5' 17.2'; Hi ∠ JNT @ 15.3' 16.5' 16.9'
1247	18.5									Core Barrel Break @ 17.4'
								Total Depth 18.5'		
								Screen 8.5'-18.5' →		2" PVC 0.010 Slot
								Sand 6'-18.5' →		~100# Bag 0 Sand
								Pellets 3'-6' →		~58# Bag Bentonite Plug

REMARKS Gemco GT 350 HSA Rig ATV
3" x 24" SS (140# wt, Cat Head, 30" Drop)
4" Temp Steel Casing w/ spin Cutter Head 0' to 8.5'
HQ (3½" OD) Core 2.5' to 18.5'
3⅞" ∅ Roller bit 0' to 2.5'

BORING 4MW1S PAGE 1 OF 1

* See Legend on Back

000001

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSB-NLON
PROJECT NUMBER: 5082
DRILLING COMPANY: EDI, Inc.
DRILLING RIG: Tripod
BORING NUMBER: 3MW37S
DATE: 5-19-99
GEOLOGIST: T. Evans
DRILLER: A. Orlicky

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
	0.0								Time				
S-1		3 / 2	0.7/2.0			Dk Brn	Humus	Pt	1330 Wet	0	0		0
	2.0	5 / 1		~2.0'									
* S-2		8 / 15	1.3/2.0		V Dense	Tan Brn	Silty F SAND	SP	1352	0	0		0
	4.0	37 / 46					Tr Rock Frags		Refusal @ 4'				
									~~Ledge~~ BR				
	6.0			5.5					5/20 @ 1210				
									Drive 4" temp				
									Casing to 5' @ location				
							set 1' screen (10 slot)		4.5-5.5	~	2' NE		
							Valve #1 Sand		3.5-5.5				
							Bentonite		2.5-3.5				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 3" SS ; ~ 20yds west of seep
* Sample

Drilling Area Background (ppm): Ø

Converted to Well: Yes ✓ No ____ Well I.D. #: 3MW37S

Tetra Tech NUS, Inc.

BORING LOG

Page 1 of ___

PROJECT NAME: NSB-NLON
PROJECT NUMBER: 5082
DRILLING COMPANY: EDI, Inc.
DRILLING RIG: Tripod w/ Cathead

BORING NUMBER: 2wMW39DS
DATE: 5-18-99
GEOLOGIST: T. Evans
DRILLER: A-O-licky

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Sample	Sampler BZ	Borehole**	Driller BZ**
	0.0								Time				
S-1		2 / 3	1.5/2.0	0.4	Loose	Brn	Silt Some F Sand M-C Sand	ML SP	1340 Photo#	0	0		0
	2.0	2 / 4							Saturated				
S-2		3 / 3	0.5/2.0		Loose	DBrn	F-C Sand	SW	1345	0	0		0
	4.0	3 / 3											
S-3			0.0/2.0				No Recovery		1348	0	0		0
	6.0												
S-4		7 / 4	0.1/2.0		M Stiff		Poor Recovery		1420	—			
	8.0	3 / 3				olive brn	Clayey Silt in Shoe	OH					
S-5		4 / 3	1.1/2.0		M Stiff	olive brn	Clayey Silt Tr Shell	OH	1445	37.8			
	10.0	3 / 2											
S-6		1 / 2	1.8/2.0		Soft				1505	72.2	0		0
	12.0	2 / 1											
S-7		4 / 2	2.0/2.0		Soft				1513	111	0		0
	14.0	3 / 1											
S-8		5 / 4	2.0/2.0		M Stiff				1520	29.9			
	16.0	4 / 3		EOB									
									Drive 4" temp casing to 15'				
							2" PVC 4-14		1600				
							#0 Sand 3-15		Let well				
							Bentonite 2-3						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 3" SS
* Sample 2W-SL-39DS-00-99

Drilling Area Background (ppm): 0

Converted to Well: Yes ______ No ______ Well I.D. #: ______

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSB-NLON
PROJECT NUMBER: 5082
DRILLING COMPANY: EDI, Inc.
DRILLING RIG: Tripod w/cat head

BORING NUMBER: 2WMW46DS
DATE: 5-17-99
GEOLOGIST: T. Evans
DRILLER: A. Orlicky

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
	0.0								Time				
S-1		13/8	0.9/2.0		–	Brn	Root matter	PT	0949	0.0			0.0
	2.0	6/6							wet				
S-2		4/7	0.0/2.0		–		No Recovery	–	1000	—			
	4.0	6/3											
S-3		4/2	1.0/2.0		V Soft	olive brn-gray	Organic Clayey Silt	OH	1020	8.0	0.0		0.0
	6.0	1/1											
S-4		2/1	2.0/2.0		M Stiff	olive brn	Organic Clayey Silt	OH	1030	123	0.0		0.0
	8.0	2/3											
S-5		2/2	2.0/2.0		Soft	olive brn	Organic Clayey Silt Tr Roots (remnant)	OH	1040 H2S odor; Drive 4" temp Casing	33.5			
	10.0	2/2											
S-6		2/2	2.0/2.0		M Stiff	olive brn	Organic Clayey Silt	OH	1100 H2S odor	99.4	0.0		0.0
	12.0	2/3											
S-7		4/3	2.0/2.0		M Stiff	olive brn	Organic Clayey Silt Tr Shell	OH	1125	124	0.0		0.0
	14.0	2/3											
S-8		5/3	2.0/2.0		Soft	↓	↓	↓	1130	132	0.0		0.0
	16.0	2/1											
									4" Temp Casing to 15'				
							2" PVC 6-Slot	4-	14'				
							Valve #0 Sand	3'-	15'				
							Bentonite 2-3'						
							Protective Casing		2.5' Stickup				
									1240 Ends				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: 2" SS
* Sample 2W-SW-46DS-04-99

Converted to Well: Yes ✓ No ____ Well I.D. #: 2WMW46DS

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME:	NSB New London, CT Site 3	BORING No.:	3MW15I
PROJECT NUMBER:	CTO 038, G00083	DATE:	4/27/06
DRILLING COMPANY:	New England Boring Contractors	GEOLOGIST:	Colin Doolan
DRILLING RIG:	Mobile B59 Drill	DRILLER:	S. Ramsdell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
S-1 0905		2 / 3	.6 / 2		loose	brown	organic silt and	SM	2 ft. fill	0			
	2	6 / 7					fine sand, some med. sand.	SM	damp	0			
							(fill)						
	5												
S-2 0920		26 / 83	.5 / 2		loose	tan to	rock fragments,	GP	refusal after 1st foot of	0			
	7					light grey	gravel, pebbles, cobbles		spoon				
									damp to dry				
	10												
S-3 0944		41 / 63	1 / 2		loose	brown orange	cobbles, pebbles, gravel	GP	damp	0			
	12	33 / 44				brown and	and coarse sand, with some fine sand	GP		0			
						grey							
	15												
S-4 1000		15 / 12	1 / 2		loose	tan	gravel and sand	GP	moist	0			
	17	22 / 20				to light	some pebbles	GP		0			
						brown							
	20												
S-5 1015		8 / 11	1.3 / 2		loose	light brown	sand, well sorted	SM	v. moist to	0			
	22	9 / 9					med. sand	SM	wet	0			
	25												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4¼" ID augers, 2' split spoons

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____ Well I.D. #: 3MW15I

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSB New London, CT Site 3
PROJECT NUMBER: CTO 038, G00083
DRILLING COMPANY: New England Boring Contractors
DRILLING RIG: Mobile B59 Drill
BORING No.: 3MW15I
DATE: 4/27/06 – 5/2/06
GEOLOGIST: Colin Doolan
DRILLER: S. Ramsdell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ
	25												
S-6 1025		5 / 7	2 / 2		loose	light brown	med. sand well sorted	SM	moist	0			
	27	9 / 13						SM		0			
	30												
S-7 1035		4 / 7	2 / 2	30.5'	loose ↓	brown ↓	coarse sand well sorted	SM	saturated ↓	0			
	32	7 / 9			med dense		fine sand to silt	SM		0			
									water table: 30.5'				
	35												
S-8 1100		6 / 9	2 / 2		loose to med dense	brown ↓	very fine sand	SM	saturated ↓	0			
	37	12 / 12						SM		0			
	40												
S-9 1110		4 / 9	2 / 2		med dense	brown ↓	fine to v. fine sand and silt	SM		0			
	42	12 / 16						SM		0			
	45												
S-10 1130		7 / 9	2 / 2		med dense	brown ↓	very fine sand with some silt	SM		0			
	47	13 / 17						SM		0			
	50												

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____ Well I.D. #: 3MW15I

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSB New London, CT Site 3
PROJECT NUMBER: CTO 038, G00083
DRILLING COMPANY: New England Boring Contractors
DRILLING RIG: Mobile B59 Drill
BORING No.: 3MW15I
DATE: 4/27/06 - 5/2/06
GEOLOGIST: Colin Doolan
DRILLER: S Ramsdell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ
	50												
S-11 1159		8 / 9	1.5 / 2		med dense	brown	Fine sand	SM	saturated	0			
	52	12 / 14					well sorted	SM		0			
	55												
S-12 1210		7 / 10	1.5 / 2		med dense	brown	fine to v. fine sand w/some silt	SM		0			
	57	10 / 11						SM		0			
	60												
S-13 @ 1030		11 / 29	1.5/2		V DENSE	BRN	SILTY F SAND	SM	WET	0			
	62	31 / 37		61.5	V. DENSE	BRN	FINE/MED SAND - SOME GRAVEL	SW	WET - SUB ANG GRAVEL 3/4"Φ MAX.SIZE.	0			
S-14	65												
@ 1125	66	24 / 100	.8/1		V DENSE	BRN	SILTY FINE/MED SAND TR. GRAVEL AND ROCK FRAGS	SW	WET - COULD BE T.O.R.	0			
				BOTM @ 66'					AUGER REFUSAL @ 66'±	0			
							SCREEN 55.5-65.5						
							SAND 54-66		4 BAG SAND				
							CHIPS 52-54		1/2 BAG CHIPS				
									6 BAGS TOTAL				

4/27/06
5/2/06

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: USED BAGS SAND
USED " CEMENT

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____ Well I.D. #: 3MW15I

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSB New London, CT Site 3
BORING No.: 3MW15S
PROJECT NUMBER: CTO 038, G00083
DATE: 4/27/06
DRILLING COMPANY: New England Boring Contractors
GEOLOGIST: Colin Doolan
DRILLING RIG: Mobile B59 Drill
DRILLER: S. Ramsdell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
	5						See boring log 3MW15I for lithology description						
	10												
	15												
	20												
	25												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4 1/4" ID augers

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____ Well I.D. #: 3MW15S

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSB New London, CT Site 3
PROJECT NUMBER: CTO 038, G00083
DRILLING COMPANY: New England Boring Contractors
DRILLING RIG: Mobile B59 Drill

BORING No.: 3MW15S
DATE: 4/27/06
GEOLOGIST: Colin Doolan
DRILLER: S. Ramsdell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ
	25												
							see boring log 3MW15I for Lithology description						
	30												
	35												
	39						total depth: 39'						
							sand: 26' - 39'						
							screen: 28' - 38'						

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ___ Well I.D. #: 3MW15S

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSB New London, CT Site 3
PROJECT NUMBER: CTO 038, G00083
DRILLING COMPANY: New England Boring Contractors
DRILLING RIG: Mobile B59 Drill
BORING No.: 3MW16D
DATE: 4/19/06 - 4/26/06
GEOLOGIST: Colin Doolan
DRILLER: S. Ramsdell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
S-1 1410		4 / 6	1 / 2		loose	brown	organic clayey silt,	SM	2 ft. fill	0			
	2	4 / 3					some sand, a few	SM	material	0			
							cobbles (fill material)						
	5								driller noticed grinding augers at 4'				
S-2 1430		34 / 30	1 / 2		dense	light grey to tan	quartz and feldspar fragments, pebbles			0			
	7	48 / 48					and cobbles w/sand		weathered granite	0			
							refusal at 9.5'		used solid augers to 10' to avoid dammaging augers				
4/19/06	10						competent bedrock						
4/21/06							coarse grained granitic gneiss		casing to 14'				
4/21/06													
4/24/06	15												
Core 1 1300						pink to grey and black	coarse grained granitic gneiss some bands of fine grained		solid few fractures				
	20						a few minor fractures						
Core 2 1345							coarse grained granitic gneiss						
							some bands of fine grained						
	25												

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4¼" ID augers, 2' split spoons
coring below 9.5'

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____ Well I.D. #: 3MW16D

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSB New London, CT Site 3
PROJECT NUMBER: CTO 038, G00083
DRILLING COMPANY: New England Boring Contractors
DRILLING RIG: Mobile B59 Drill
BORING No.: 3MW16D
DATE: 4/19/06 — 4/26/06
GEOLOGIST: Colin Doolan
DRILLER: S. Ramsdell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	Sample	Sampler BZ	Borehole**	Driller BZ**
	25												
Core 3 1430						pink to grey and black	granitic gneiss coarse to fine grained banded		few fractures				
	30												
Core 4 1525						pink	coarse grained pink granitic gneiss		few fractures				
						grey and black	fine grained grey and black granitic gneiss		water pumped from bore hole, recovered 1 ft in 2 min.				
4/24/06	35												
4/25/06 Core 5 0930						grey and black	light and dark banded granitic gneiss		Static water level at ~15' bgs				
									two minor fractures				
	40												
Core 6 1010						black grey and white	light and dark banded granitic gneiss		multiple fractures				
	45												
Core 7 1100						pink to grey	coarse to fine grained granitic gneiss		no fractures				
	50												

PID/FID Reading (ppm)

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____ Well I.D. #: 3MW16D

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSB New London, CT Site 3
PROJECT NUMBER: CTO 038, G00083
DRILLING COMPANY: New England Boring Contractors
DRILLING RIG: Mobile B59 Drill
BORING No.: 3MW16D
DATE: 4/19/06 - 4/26/06
GEOLOGIST: Colin Doolan
DRILLER: S. Ramsdell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	50												
Core 8						pinky	alternating coarse		some				
1340						white and	and fine grained		fractures				
						grey	granitic gneiss						
4/25/06	55												
4/26/06 Core 9						black grey	coarse grained						
0840						and white	granitic gneiss		fractured				
						some pink	dark fine grained						
							banding.						
	60												
Core 10						grey and	coarse grained						
0945						black some	granitic gneiss		few fractures				
						pink	trace fine grained						
	65												
Core 11						pink	coarse to fine						
1040						grey and	grained granitic		some fractures				
						black	gneiss						
	69						total depth: 69						
							sand: 57' - 69'						
							screen: 59' - 69'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____ Well I.D. #: 3MW16D

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME:	NSB New London, CT Site 3	BORING No.:	3MW16S
PROJECT NUMBER:	CTO 038, G00083	DATE:	4/21/06 - 4/26/06
DRILLING COMPANY:	New England Boring Contractors	GEOLOGIST:	Colin Doolan
DRILLING RIG:	Mobile B59 Drill	DRILLER:	S. Ramsdell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ
	0												
					loose	brown	organic clayey silt	SM	2 ft fill				
							fill material	SM	material				
							a few cobbles						
	5												
					dense	light grey to tan	quartz and feldspar fragments, pebbles and cobbles w/ sand		weathered granite				
							refusal at 8.5' competent bedrock						
	10												
									casing to 13'				
4/21/06													
4/26/06	14												
Core 1						pink gray	granitic gneiss coarse to fine grained						
1330						black			large verticle fracture w/ some smaller				
	19												
Core 2						black to	fine grained						
1400						grey/white	granitic gneiss		few fractures				
						some pink	some coarse grained						
							biotite rich						
	24												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4 1/4" ID augers, 2' split spoons coring below 8.5' (5 ft)

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____ Well I.D. #: 3MW16S

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSB New London, CT Site 3
PROJECT NUMBER: CTO 038, G00083
DRILLING COMPANY: New England Boring Contractors
DRILLING RIG: Mobile B59 Drill
BORING No.: 3MW16S
DATE: 4/21/06 - 4/26/06
GEOLOGIST: Colin Doolan
DRILLER: S. Ramsdell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ
	24												
Core 3													
1520							v coarse grained		few fractures				
							granitic gneiss						
							with some						
	28						fine grained						
									total depth: 28'				
							sand: 15' - 28'						
							Screen: 17' - 27'						

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____ Well I.D. #: 3MW16S

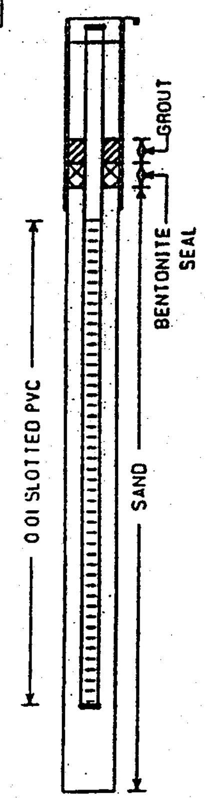
BORING LOG 2D MW 16S

PROJECT: IR STUDY NSB - NLON
PROJECT NO: 1256-10
LOCATION: AREA A DOWNSTREAM
DATE STARTED: 09/18/90
DATA COMPLETED: 09/19/90
DRILLING CONTRACTOR: EMPIRE SOILS INVESTIGATIONS, INC.
DRILLER: JOE RAAB
DRILLING METHOD: HOLLOW STEM AUGER
SAMPLING METHOD: SPLIT SPOON

GROUND ELEVATION: 35.6
PROTECTIVE CASING ELEVATION: 38.08
WELL ELEVATION: 37.85
WATER LEVEL: 34.30 (03/21/91)
DATUM: SUBASE
WEATHER: 60°, CLEAR SKIES, VERY WINDY
INSPECTOR: LYNN METCALF AND ERIK NESS
CHECKED BY: ERIK NESS

SPLIT SPOON SAMPLE DEPTH (ft)	BLOWS PER 6"	% RECOVERY	HNU (ppm)	SOIL DESCRIPTION (color, SOIL, admixture, moisture, other notes, ORIGIN)	LEL %	RAD. (cpm)	LITHOLOGY DEPTH (FT.)
0-2	5 7 10 11	50	0.2	Dark brown, fine SAND and SILT, trace roots, moist, TOP SOIL / Brown, medium to coarse SAND and GRAVEL, trace silt, moist	0	40	0.0 / 0.5
2-4	6 9 10 11	30	0.4		0	50	
4-6	100/5	5	0.2		0	50	
6-8	26 30 13 7	50	0.2	Grey, fine to very fine SAND and SILT, wet	1	50	6.0
8-10	6 20 31 45	60	0.2	Brown, fine to medium SAND and GRAVEL, trace silt, wet	1	40	8.0
10-12	42 100/5	100	0.2		1	50	
12-14	100/5	100	0.2		1	40	13.5
				AUGER REFUSAL AT 13.5 feet			

WELL CONSTRUCTION



ATLANTIC

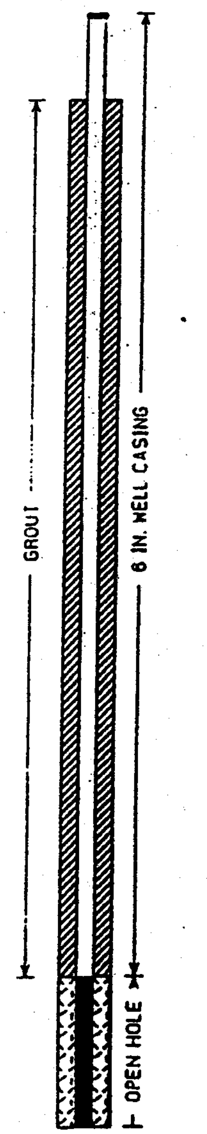
BORING LOG 2D MW 16D

PROJECT: IR STUDY NSB - NLON
PROJECT NO: 1256-10
LOCATION: AREA A DOWNSTREAM
DATE STARTED: 09/13/90
DATA COMPLETED: 09/18/90
DRILLING CONTRACTOR: EMPIRE SOILS INVESTIGATIONS, INC.
DRILLER: CRAIG CONNER
DRILLING METHOD: AIR ROTARY
SAMPLING METHOD:

GROUND ELEVATION: 35.9
PROTECTIVE CASING ELEVATION: 37.69
WELL ELEVATION: 37.69
WATER LEVEL: 3.74 (03/21/91)
DATUM: SUBASE
WEATHER: 50-60°, CLEAR SKIES
INSPECTOR: AKHTER HOSSAIN AND LYNN METCALF
CHECKED BY: ERIK NESS

SPLIT SPOON SAMPLE DEPTH (ft)	BLOWS PER 6"	% RECOVERY	HNU (ppm)	SOIL DESCRIPTION: color, SOIL, admixture, moisture, other notes, ORIGIN	DEPTH (FT.)	VISUAL CONTAM.: NONE	STAIN	SHEEN	HEAVY	LEL %	RAD. (cpm)	SAMPLE ANALYSIS	LITHOLOGY	DEPTH (FT.)
				FOR SOIL DESCRIPTION SEE BORING LOG 2DMW16S	0									0.0
					5									
					10									
				BEDROCK										12.5
					15									
					20									

WELL CONSTRUCTION

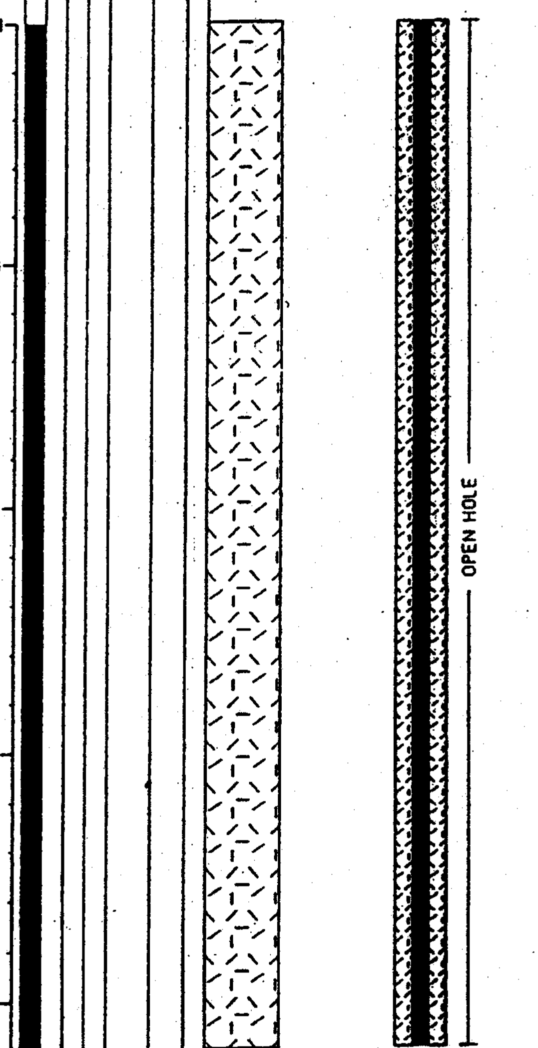


BORING LOG 2D MW 16D

PROJECT: IR STUDY NSB - NLON
PROJECT NO: 1256-10
LOCATION: AREA A DOWNSTREAM
DATE STARTED: 09/13/90
DATA COMPLETED: 09/18/90
DRILLING CONTRACTOR: EMPIRE SOILS INVESTIGATIONS, INC.
DRILLER: CRAIG CONNER
DRILLING METHOD: AIR ROTARY
SAMPLING METHOD:

GROUND ELEVATION: 35.9
PROTECTIVE CASING ELEVATION: 37.69
WELL ELEVATION: 37.69
WATER LEVEL: 3.74 (03/21/91)
DATUM: SUBASE
WEATHER: 50-60°, CLEAR SKIES
INSPECTOR: AKHTER HOSSAIN AND LYNN METCALF
CHECKED BY: ERIK NESS

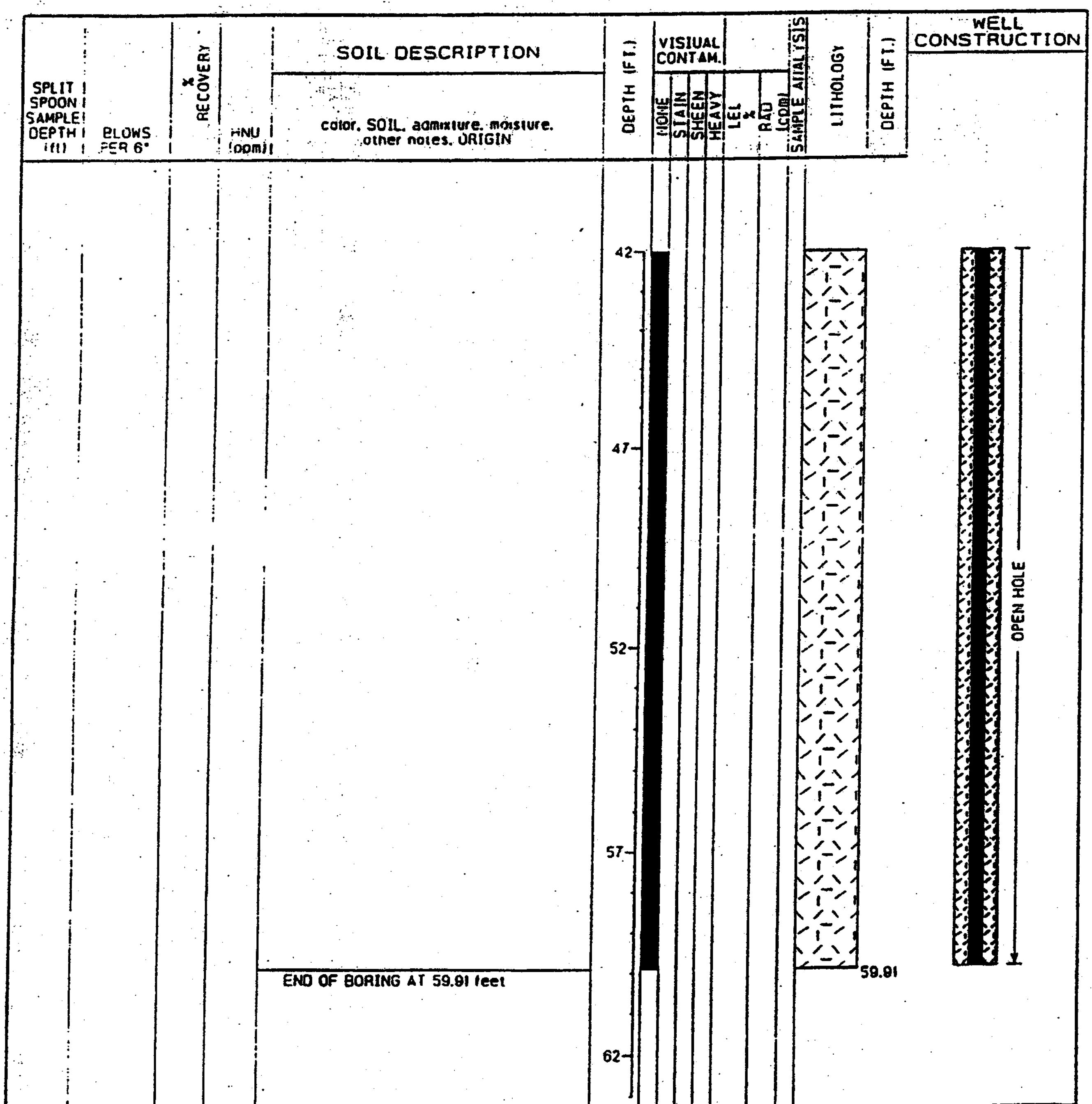
SPLIT SPOON SAMPLE DEPTH (ft)	BLOWS PER 6"	% RECOVERY	HNU (ppm)	SOIL DESCRIPTION color, SOIL, admixture, moisture, other notes, ORIGIN	DEPTH (FT.)	VISUAL CONTAM. NONE	STAIN	SHEEN	HEAVY	LEL %	RAD. (cpm)	SAMPLE ANALYSIS	LITHOLOGY	DEPTH (FT.)	WELL CONSTRUCTION
					21										
					26										
					31										OPEN HOLE
					36										
					41										



BORING LOG 2D MW 16D

PROJECT: IR STUDY NSB – NLON
PROJECT NO: 1256-10
LOCATION: AREA A DOWNSTREAM
DATE STARTED: 09/13/90
DATA COMPLETED: 09/18/90
DRILLING CONTRACTOR: EMPIRE SOILS INVESTIGATIONS, INC.
DRILLER: CRAIG CONNER
DRILLING METHOD: AIR ROTARY
SAMPLING METHOD:

GROUND ELEVATION: 35.9
PROTECTIVE CASING ELEVATION: 37.69
WELL ELEVATION: 37.69
WATER LEVEL: 3.74 (03/21/91)
DATUM: SUBASE
WEATHER: 50-60°, CLEAR SKIES
INSPECTOR: AKHTER HOSSAIN AND LYNN METCALF
CHECKED BY: ERIK NESS



BORING LOG | **HALLIBURTON NUS**

PROJECT: NSB-NLON BORING NO.: 2DMW29S
PROJECT NO.: 9594 DATE: 11-30-93 DRILLER: EAST COAST THOMAS/ BRETT SWIATEK
ELEVATION: ______ FIELD GEOLOGIST: T. EVANS
WATER LEVEL DATA: ______
(Date, Time & Conditions) ______

SAMPLE NO. & TYPE OR RQD	DEPTH (FT) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth/Ft.)	MATERIAL DESCRIPTION*: SOIL DENSITY/CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BRK. OR USCS	REMARKS (HNSU)
S-1	0.0	14 / 14	2.0/2.0		M. DENSE	BRN	SAND w/ SOME GRAVEL	SW	Max ϕ 0.15" (0 ppm)
@ 1400	2.0	14 / 11					(FILL)		
S-2		7 / 6	0.9/2.0		M. DENSE	BRN	SILTY SAND w/ GRAVEL	SM	MOIST (0 ppm)
	4.0	5 / 5					& SAND (FILL)		Poorly Graded Sand
S-3		4 / 3	1.9/2.0		LOOSE	TAN	SAND	SP	MOIST (0 ppm)
	6.0	3 / 3							Fine, Poorly Graded
S-4		3 / 2	1.3/2.0	6.0'	LOOSE	TAN TO RUST	SAND W/TR ROOTS	SP	WET (0 ppm)
	8.0	3 / 6							Fine, Poorly Graded
S-5		3 / 5	1.0/2.0		M. DENSE	TAN TO RUST	SAND	SP	SATURATED (0 ppm)
	10.0	6 / 7							Fine, Poorly Graded
S-6		3 / 5	1.8/2.0		M. DENSE	TAN TO BRN	SAND	SP	(0 ppm)
	12.0	7 / 9				—			Fine, Poorly Graded
S-7		8 / 13	2.0/2.0		DENSE	TAN TO BRN		SP	
	14.0	19 / 10							
S-8		8 / 11	1.3/2.0		M. DENSE			SP	
@ 1440	16.0	12 / 13		16.0'					
							HSA to 16'		SCREEN 6'-16'
							SS to 16'		SAND 5'-16'
							8 SAMPLES		PELLETS 3'-5'
							TOTAL DEPTH 16'		

REMARKS: CME 75 HSA RIG
4¼" ID AUGER
2" SS TO SAMPLE (140# Wt, 30" DROP)

BORING 2DMW29S
PAGE 1 OF 1

* See Legend on Back

000040

BORING LOG **HALLIBURTON NUS**

PROJECT: NSB-NLON
BORING NO.: 7MW5S
PROJECT NO.: 9594
DATE: 3-8-94
DRILLER: EAST COAST THOMAS
ELEVATION:
FIELD GEOLOGIST: Tim Evans / Tim Sabo
WATER LEVEL DATA:
(Date, Time & Conditions)

SAMPLE NO. & TYPE OR RQD	DEPTH (Ft.) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.)	SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
	0.0 0.5						Asphalt		OVM
S-1 @ 1340	1.5	22 13	1.0/1.0		Dense	Tan	Silty Sand w/ Tr Gravel & wood	SM	Top 2" M to C Gr
S-2 @ 1348	2.0	100/3.5 (?) 28 10	0.5/0.5		V Dense				Auger Refusal @ 1.75' Move 2' SW
S-3 @ 1414	3.5 4.0	11	1.4/2.0		M.Dense				
S-4 @ 1425	6.0	8 5 13 14	1.7/2.0		M.Dense	Tan	Silty Sand w/ Tr Gravel	SM	F Gr Fe-Stain/Mottled
S-5 @ 1433	8.0	7 14 21 17	1.0/2.0		Dense				
S-6 @ 1441	10.0	13 35 48 89	1.7/2.0		V.Dense	D.Brn	Silty Sand & Gravel Cobble	SM/GM	Moist
S-7 @ 1400	11.0	22 100	0.6/1.0		V.Dense	D.Brn			
S-8 @ 1506	12.0	100/0.0	0.1/0.0						Very Micaceous
								VBr	Auger Refusal @ 12'
								Br	0945 Rock blocked in core barrel
1.5/2.5	1	60%	2.5/5.0		Hard	Gray	Gneiss		Hi ∠ Frac 12.25' 14.0'
									Poor Recovery Highly Fractured
	17.0								Cave-In to 14.0'
							-Total Depth 17'-		3/14 Spin Casing to 14.7'
									H_2O level 9.35' GS @ 1700
									3/15 @ 0822 12.1' GS Rollerbit to 17'
									Spin Casing to 16.5'
							Screen 7'-17' →		10'-2" PVC (Schedule 40 0.010 Slot)
							Sand 6'-17' →		1-100# Bag Ottawa Sand
							Pellets 2.5'-6' →		1-50# Bag

Left margin: 1/8 (?), 3/9 .925 (?), .20

REMARKS Diedrich D-50 HSA Rig (Bombadier Mounted)
3" x 24" SST (30" Drop, 140# wt, Cat Head)
4¼" ID, 8" OD Auger
4" Spin Casing
3⅞" Rollerbit

* See Legend on Back

BORING 7MW5S

PAGE 1 OF 1

000010

BORING LOG **HALLIBURTON NUS**

PROJECT: NSB-NLON BORING NO.: 7MW5D
PROJECT NO.: 9594 DATE: 3-15-95 DRILLER: EAST COAST THOMAS
ELEVATION: FIELD GEOLOGIST: James R. Ferguson
WATER LEVEL DATA:
(Date, Time & Conditions) 3-15-95 OVERCAST RAIN 45° 3-16-95 CLEAR 45°

SAMPLE NO. & TYPE OR RQD	DEPTH (Ft.) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth/Ft.)	MATERIAL DESCRIPTION* SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BK. OR USCS	REMARKS
							SEE BORING LOG 7MW5S		
							FOR LITHOLOGIC DETAILS		SET 6¼" Ø STEEL CASING
							FROM G.S. TO 15.0'		FROM G.S. TO 16.0'
	14-15								
						PINK-GRAY-BLACK	GRANITE BIOTITE QUARTZ and		WELL BEGAN producing
							K SPAR		a significant quantity
									of water between 18' and
									25'
	19-20					PINK-GRAY BLACK	GRANITE BIOTITE QUARTZ and		
							K SPAR		
	24-25					GRAY-BLACK	GNEISS		
	29-30					GRAY-BLACK	GNEISS		
	34-35					GRAY-BLACK	GNEISS		

REMARKS Driller: Dick Spaulding Rig: Chicago Pneumatic

BORING 7MW5D

PAGE 1 OF 2

* See Legend on Back

000012

BORING LOG **HALLIBURTON NUS**

PROJECT: NSB-NLON BORING NO.: 7MW5D

PROJECT NO.: 9594 DATE: 3-15-94 DRILLER: EAST COAST THOMAS

ELEVATION: FIELD GEOLOGIST: J.P. FERGUSON

WATER LEVEL DATA:

(Date, Time & Conditions) 3-15-95 OVERCAST RAIN 45° 3-16-95 CLEAR 45°

SAMPLE NO. & TYPE OR RQD	DEPTH (Ft.) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth/Ft.)	MATERIAL DESCRIPTION*			ROCK BR. or USCS	REMARKS
					SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION		
									No significant water
	39-41					GRAY-BLACK	GNEISS		bearing zones were
									noticed during drilling
	41-42								17:00
							Bottom of Boring: 42.0'		
							Installed 2" PVC Monitoring		→ 3-16-95
							well Screen 32'-42',		
					—	—	Sandpack 28.5-42.0' Bentonite		——
							pellet seal 14.5'-28.5' Cement		
							14.5'-2.5'		

REMARKS Well Construction Diagram on P. 123 of Notebook 2??0

BORING 7MW5D

PAGE 2 OF 2

* See Legend on Back

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSB New London, CT Site 7
PROJECT NUMBER: CTO 038, G00083
DRILLING COMPANY: New England Boring Contractors
DRILLING RIG: Mobile B59 Drill
BORING No.: 7MW12I
DATE: 5/17/06
GEOLOGIST: Colin Doolan
DRILLER: S. Ramsdell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
					loose	dk brown to	organic top soil	OL	fill material	0		0	
					↓	brown	sandy silt	SM	v. wet	0			
				3'					water table				
									at 3'				
	5												
S-1 0837		1 / 2	2 / 2		loose	dk orange brown	0.5 ft coarse sand 1.0 ft silt trace clay	SM	saturated (fill) v wet	0			
		3 / 16			↓ med dense	grey brown	trace roots 0.5 ft silt		moist	0			
	10												
S-2 0850		7 / 7	1.5 / 2		med dense	orange green brown	silt	SM	wet ↓	0			
		9 / 11			dense	blue grey			moist	0			
	15												
S-3 0915		7 / 12	2 / 2		med dense	blue grey	fine sand w silt	SM	saturated	0		0	0
		24 / 31			to dense	lt brown	sandy silt		to wet	0			
	20												
S-4 0920		12 / 14	1.3 / 2		dense	brown	silt	SM	saturated	0	0		
		18 / 21				blue grey	silt w/ trace clay			0			
	25												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4 1/4 ID augers, 2' split spoons

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____

Well I.D. #: 7MW12I

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSB New London, CT Site 7
PROJECT NUMBER: CTO 038, G00083
DRILLING COMPANY: New England Boring Contractors
DRILLING RIG: Mobile B59 Drill
BORING No.: 7MW12I
DATE: 5/17/06
GEOLOGIST: Colin Doolan
DRILLER: S. Ramsdell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sampler	Sampler BZ	Borehole**	Driller BZ
	25												
S-5 0950		7 / 12	1.8 / 2		stiff	blue grey	1 pt. silt w/ clay	SC	damp	0			
		14 / 20			dense		1 pt silt	SM	↓	0			
	30												
S-6 1010		100	0.5 / 2		dense	brn to grey	silt	SM	bedrock refusal at 30.5'	0			
							total depth: 30'						
							sand: 18'-30.5'						
							screen: 20'-30'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4¼" ID augers, 2' split spoons

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____ Well I.D. #: 7MW12I

BORING LOG

PROJECT NAME: NSB-NLON - Data Gap
PROJECT NUMBER: CTO 841 # 4286
DRILLING COMPANY: New England Boring
DRILLING RIG: DPT
BORING NUMBER: 15TW3
DATE: 10.22.02
GEOLOGIST: Keith Simpson
DRILLER: JEFF LEAVITT

1100

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	Sample	Sampler BZ	Borehole**	Driller BZ**
	1					BRN	ASPHALT/ GRAVEL		DRY	0	0	0	0
	2				MED STIFF		C. SAND & GRAVEL	SW	MOIST				
	3												
	4		3/4										
	5					GY.	F. SAND & SILT - ROOT FRAGS		GRAY TO OLIVE COLOR				
	6			▽				SM	WET				
	7					BRN	COURSE SAND						
	8		4/4				FINE SAND TR. SILT		BRN/GRAY				
	9				SOFT								
	10												
	11												
	12						TR. RUST COLOR						
	13						MOTTLING THRU-OUT						
	14												
	15												
	16			TD			HOLE CAVED @						
	17						3' - OFFSET						
	18						2' NE						
	19												
	20												
							TOTAL 30' OF DPT						
							15' TW CONSTRUCTION						
							TD = 15						

1140

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: CUT ASPHALT WITH DPT DRILL BIT

Drilling Area Background (ppm): 0

Converted to Well: Yes ______ No ______ Well I.D. #: ______

BORING LOG **HALLIBURTON NUS**

PROJECT: NSB-NLON
BORING NO.: 2WCMW25
PROJECT NO.: 9594
DATE: 1-20-94
DRILLER: EAST COAST THOMAS
ELEVATION:
FIELD GEOLOGIST: J. R. FERGUSON
WATER LEVEL DATA:
(Date, Time & Conditions) 1-20-94 - 5°

SAMPLE NO. & TYPE OR RQD	DEPTH (Ft.) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth/Ft.)	MATERIAL DESCRIPTION*: SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BR. OR USCS	REMARKS	
	0-1						Asphalt and gravel Sub-base			
S-1	2-4	12 8	1.0		M. Dense	BROWN	SILTY, FINE TO COARSE SAND	SW	HNU-0	15:27
		4 4	2.0			BROWN	SOME GRANITIC ROCK FRAGMENTS	SW	MOIST	
S-2	4-6	5 3	.6		LOOSE	BROWN		SW	HNU-0	15:34
		3 3	2.0		▽	BROWN		SW	WET (DROVE 2 SPOONS)	
S-3	6-8	1 1	.6		V. LOOSE	BROWN		SW	HNU-0	15:52
		1 2	2.0			BROWN		SW	WET	
S-4	8-10	1 2	.5		LOOSE	BROWN		SW	HNU-0	16:06
		3 4	2.0			BROWN		SW	WET	
S-5	10-12	3 9	.5		M. Dense	BROWN		SW	HNU-0	16:20
		20 10	2.0			BROWN		SW	WET	
S-6	12-14	4 3	1.0		LOOSE	BROWN		SW	HNU-0	16:34
		4 7	2.0			BROWN		SW	WET	
S-7	14-16	4 5	1.6		LOOSE	BROWN-BLACK		SM	HNU-0	16:42
		1 1	2.0		M. STIFF	BLACK	ORGANIC CLAYEY SILT, TR ORG	ML	WET/moist	
S-8	16-18	W O	2.0		V. Soft	GREEN-GRAY	material, wood etc.		HNU-0	16:56
		R 1	2.0			GREEN-GRAY			MOIST	
							BOTTOM OF BORING = 18.0			

REMARKS: RIG CME 75 - FLOYD CROSS

BORING 2WCMW25

PAGE 1 OF 1

* See Legend on Back

000003

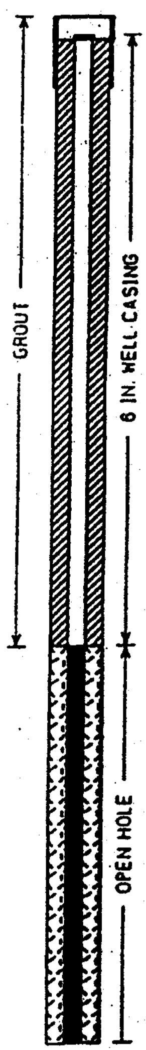
BORING LOG 2W MW 4D

PROJECT: IR STUDY NSB - NLON
PROJECT NO: 1256-10
LOCATION: AREA A WETLAND
DATE STARTED: 09/19/90
DATA COMPLETED: 09/27/90
DRILLING CONTRACTOR: EMPIRE SOILS INVESTIGATIONS, INC.
DRILLER: CRAIG CONNER
DRILLING METHOD: AIR ROTARY
SAMPLING METHOD:

GROUND ELEVATION: 93.07
PROTECTIVE CASING ELEVATION: 92.69
WELL ELEVATION: 92.69
WATER LEVEL: 7.43 (03/21/91)
DATUM: SUBASE
WEATHER: 65° . CLEAR, SUNNY
INSPECTOR: AKHTER HOSSAIN AND LYNN METCALF
CHECKED BY: ERIK NESS

SPLIT SPOON SAMPLE DEPTH (ft)	BLOWS PER 6"	% RECOVERY	HNU (ppm)	SOIL DESCRIPTION (color, SOIL, admixture, moisture, other notes, ORIGIN)	DEPTH (FT.)	VISIUAL CONTAM.: NONE	STAIN	SHEEN	HEAVY	LEL %	RAD (cpm)	SAMPLE ANALYSIS	LITHOLOGY	DEPTH (FT.)
				FOR OVERBURDEN SOIL DESCRIPTION SEE BORING LOG 2WMW4S	0									0.0
					5									
				BEDROCK										9.0
					10									
					15									
					20									

WELL CONSTRUCTION

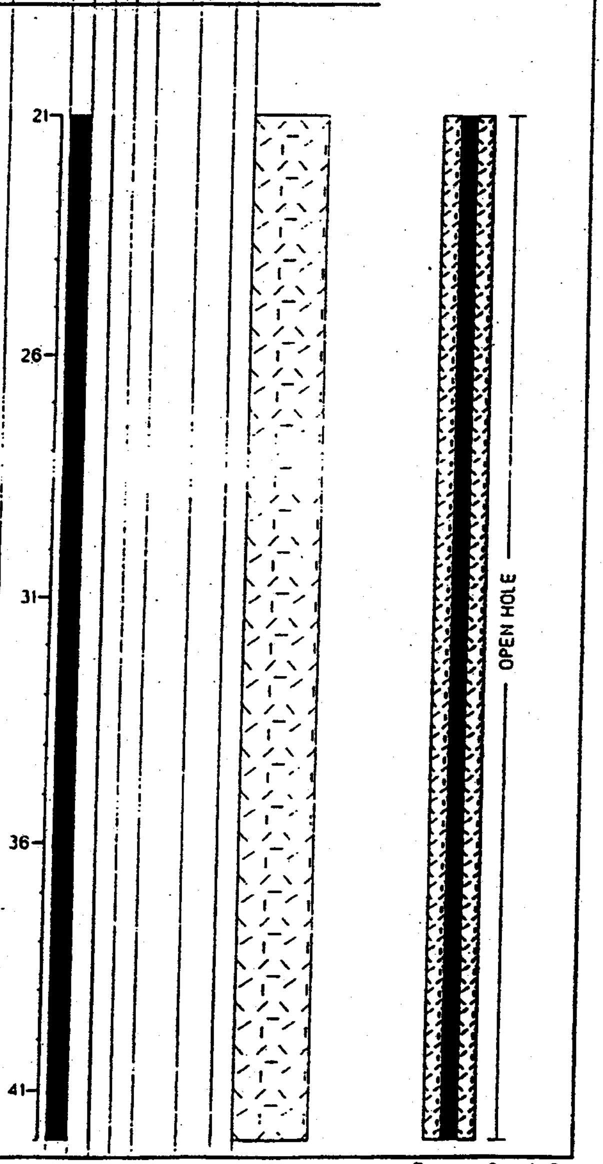


BORING LOG 2W MW 4D

PROJECT: IR STUDY NSB - NLON
PROJECT NO: 1256-10
LOCATION: AREA A WETLAND
DATE STARTED: 09/19/90
DATA COMPLETED: 09/27/90
DRILLING CONTRACTOR: EMPIRE SOILS INVESTIGATIONS, INC.
DRILLER: CRAIG CONNER
DRILLING METHOD: AIR ROTARY
SAMPLING METHOD:

GROUND ELEVATION: 93.07
PROTECTIVE CASING ELEVATION: 92.69
WELL ELEVATION: 92.69
WATER LEVEL: 7.43 (03/21/91)
DATUM: SUBASE
WEATHER: 65°, CLEAR, SUNNY
INSPECTOR: AKHTER HOSSAIN AND LYNN METCALF
CHECKED BY: ERIK NESS

SPLIT SPOON SAMPLE DEPTH (ft)	BLOWS PER 6"	% RECOVERY	HNU (ppm)	SOIL DESCRIPTION: color, SOIL, admixture, moisture, other notes, ORIGIN	DEPTH (FT.)	VISUAL CONTAM.: NONE	STAIN	SHEEN	HEAVY	LEL %	RAD. (ppm)	SAMPLE ANALYSIS	LITHOLOGY	DEPTH (FT.)	WELL CONSTRUCTION

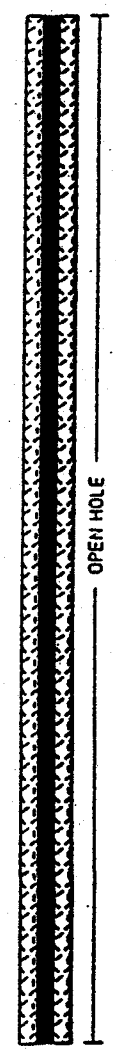


BORING LOG 2W MW 4D

PROJECT: IR STUDY NSB - NLON
PROJECT NO: 1258-10
LOCATION: AREA A WETLAND
DATE STARTED: 09/19/90
DATA COMPLETED: 09/27/90
DRILLING CONTRACTOR: EMPIRE SOILS INVESTIGATIONS, INC.
DRILLER: CRAIG CONNER
DRILLING METHOD: AIR ROTARY
SAMPLING METHOD:

GROUND ELEVATION: 93.07
PROTECTIVE CASING ELEVATION: 92.69
WELL ELEVATION: 92.69
WATER LEVEL: 7.43 (03/21/91)
DATUM: SUBASE
WEATHER: 65°, CLEAR, SUNNY
INSPECTOR: AKHTER HOSSAIN AND LYNN METCALF
CHECKED BY: ERIK NESS

SPLIT SPOON SAMPLE DEPTH (ft)	BLOWS PER 6"	% RECOVERY	HNU (ppm)	SOIL DESCRIPTION: color, SOIL, admixture, moisture, other notes, ORIGIN	DEPTH (FT.)	VISUAL CONTAM.: NONE	STAIN	SHEEN	HEAVY	LEL %	RAD. (cpm)	SAMPLE ANALYSIS	LITHOLOGY	DEPTH (FT.)	WELL CONSTRUCTION
					42										
					47										
					52										
					57										
					62										



ATLANTIC

BORING LOG 2W MW 4D

PROJECT: IR STUDY NSB – NLON
PROJECT NO: 1256-10
LOCATION: AREA A WETLAND
DATE STARTED: 09/19/90
DATA COMPLETED: 09/27/90
DRILLING CONTRACTOR: EMPIRE SOILS INVESTIGATIONS, INC.
DRILLER: CRAIG CONNER
DRILLING METHOD: AIR ROTARY
SAMPLING METHOD:

GROUND ELEVATION: 93.07
PROTECTIVE CASING ELEVATION: 92.69
WELL ELEVATION: 92.69
WATER LEVEL: 7.43 (03/21/91)
DATUM: SUBASE
WEATHER: 65°, CLEAR, SUNNY
INSPECTOR: AKHTER HOSSAIN AND LYNN METCALF
CHECKED BY: ERIK NESS

SPLIT SPOON SAMPLE DEPTH (ft)	BLOWS PER 6"	% RECOVERY	HNU (ppm)	SOIL DESCRIPTION color, SOIL, admixture, moisture, other notes, ORIGIN	DEPTH (FT.)	VISUAL CONTAM.: NONE	STAIN	SHEEN	HEAVY	LEL	RAD (ppm)	SAMPLE ANALYSIS	LITHOLOGY	DEPTH (FT.)	WELL CONSTRUCTION
					63										OPEN HOLE
					68										
					73										
					78										
					83										

ATLANTIC

BORING LOG 2W MW 4D

PROJECT: IR STUDY NSB - NLON
PROJECT NO: 1256-10
LOCATION: AREA A WETLAND
DATE STARTED: 09/19/90
DATA COMPLETED: 09/27/90
DRILLING CONTRACTOR: EMPIRE SOILS INVESTIGATIONS, INC.
DRILLER: CRAIG CONNER
DRILLING METHOD: AIR ROTARY
SAMPLING METHOD:

GROUND ELEVATION: 93.07
PROTECTIVE CASING ELEVATION: 92.69
WELL ELEVATION: 92.69
WATER LEVEL: 7.43 (03/21/91)
DATUM: SUBASE
WEATHER: 65°, CLEAR, SUNNY
INSPECTOR: AKHTER HOSSAIN AND LYNN METCALF
CHECKED BY: ERIK NESS

SPLIT SPOON SAMPLE DEPTH (ft)	BLOWS PER 6"	% RECOVERY	HNU (ppm)	SOIL DESCRIPTION: color, SOIL, admixture, moisture, other notes, ORIGIN	DEPTH (FT.)	VISUAL CONTAM.: NONE	STAIN	SHEEN	HEAVY	LEL %	RAD. (cpm)	SAMPLE ANALYSIS	LITHOLOGY	DEPTH (FT.)	WELL CONSTRUCTION
					84										
					89										
					94										OPEN HOLE
					99										
					104										

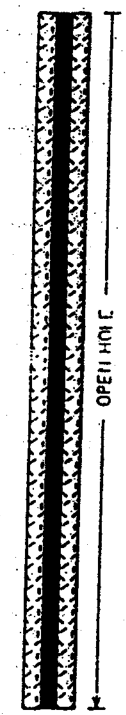
ATLANTIC

BORING LOG 2W MW 4D

PROJECT: IR STUDY NSB - NLON
PROJECT NO: 1256-10
LOCATION: AREA A WETLAND
DATE STARTED: 09/19/90
DATA COMPLETED: 09/27/90
DRILLING CONTRACTOR: EMPIRE SOILS INVESTIGATIONS, INC
DRILLER: CRAIG CONNER
DRILLING METHOD: AIR ROTARY
SAMPLING METHOD:

GROUND ELEVATION: 93.07
PROTECTIVE CASING ELEVATION: 92.69
WELL ELEVATION: 92.69
WATER LEVEL: 7.43 (03/21/91)
DATUM: SUBASE
WEATHER: 65°, CLEAR, SUNNY
INSPECTOR: AKHTER HOSSAIN AND LYNN METCALF
CHECKED BY: ERIK NESS

SPLIT SPOON SAMPLE DEPTH (ft)	BLOWS PER 6"	% RECOVERY	HNU (ppm)	SOIL DESCRIPTION color, SOIL, admixture, moisture, other notes, ORIGIN	DEPTH (FT.)	VISUAL CONTAM.: NONE	STAIN	SHEEN	HEAVY	LEL %	RAD (cpm)	SAMPLE ANALYSIS	LITHOLOGY	DEPTH (FT.)	WELL CONSTRUCTION
					105										
					110										
					115										
				END OF BORING AT 119.38 feet										119.4	
					120										
					125										



BORING LOG

PROJECT NAME: NSB-NLON
PROJECT NUMBER: CTO 241 4626
DRILLING COMPANY: SOILTEST, INC
WATER LEVEL DATA:

BORING NUMBER: HNUS 23
DATE: 10-4-95
GEOLOGIST: STAN CONTI

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows/6" or RQD (%)	Sample Recovery/Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/Consistency or Rock Hardness	Color	Material Classification	U S C S*	Remarks	PID or FID Reading (ppm)
S-1	0.0	5/11	1.8/2.0		M DENSE	BRN	SILTY SAND - TR ROOTS/	SM	MOIST	0/2
1350	2.0	13/13			↓	↓	ROCK FRAG.			
S-2		9/10	1.7/2.0		M DENSE	TAN BRN	SILTY SAND - SOME ROCK	SM	MOIST	0/2
1352	4.0	8/13			↓		FRAG			
S-3		8/6	1.5/2.0		M DENSE		FINE TO MED SAND	SM	DAMP → MOIST	0/4
1405	6.0	7/5			↓	↓	↓	SP		
S-4		1/2	1.3/2.0	7	M DENSE	TAN GRAY	SILTY F. MED SAND	SM	MOIST	0/2
1407	8.0	3/8				↓		SP		
S-5	•	9/8	1.5/2.0	9.0		GRAY	↓		MOIST → WET	0/4
1415	10.0	10/11		HIT H_2O ≈9	↓	↓	SILTY F SAND	SM	≈ 9' WET SENT	
S-6		8/10	1.6/2.0		M DENSE	BRN TO	↓		SWSO23-08	
1418	12.0	10/9				GRAY	SILTY VF SAND	SM	WET	0
									ALMOST SANDY SILT	
	15.0				↓	↓	↓			
S-7		4/5	1.8/2.0		M DENSE	TAN BRN	SILTY F SAND - SANDY	SM	WET	0/.2
1430	17.0	8/8		17.0	↓		SILT	ML	? MOTTLED w/ LAYERING	
							HSA TO 17			
							SPOONS 7			
							SCREEN 7-17			
							SAND 5-17			
							PELLETS 3-5			
							FLUSH MT (GROUT TO SURF)			

*When rock coring enter rock brokeness.

CONVERTED TO WELL: ✓ Yes ___ No:
WELL I.D.#: HNUS-23

REMARKS:
SET UP 1340 HRS. • TO LAB (SWLOK)

Signature(s):

TABLE 4-4

GROUNDWATER ELEVATIONS - ROUNDS 9 THROUGH 11
YEAR 3 GROUNDWATER MONITORING REPORT FOR AREA A LANDFILL
NSB-NLON, GROTON, CONNECTICUT

WELL ID	Reference Elevation[2] (feet)	Round 9 December-01		Round 10 March-02		Round 11 September-02	
		Depth to Water	Groundwater Elevation[2] (feet)	Depth to Water	Groundwater Elevation[2] (feet)	Depth to Water	Groundwater Elevation[2] (feet)
4MW1S	129.55	9.9 *	119.65	6.29 *	123.26	8.15	121.40
2LMW20S	86.83	18.02	68.81	15.81	71.02	16.53	70.30
2WMW21S	76.31	4.98	71.33	4.33	71.98	4.77	71.54
3MW37S	47.26	3.79 *	43.47	3.61 *	43.65	3.65	43.61
3MW12D[1]	47.22	--	--	--	--	4.44[3]	42.78
2WMW38DS	74.06	7.61	66.45	5.81	68.25	7.93	66.13
2WMW39DS	73.53	3.4 *	70.13	2.40 *	71.13	3.31	70.22
2WMW40DS	73.21	3.81	69.40	3.15	70.06	3.79	69.42
2WMW41DS	73.39	3.24	70.15	2.42	70.97	2.89	70.50
2WMW42DS	73.65	2.5	71.15	2.05	71.60	2.64	71.01
2WMW43DS	74.36	3.28	71.08	2.44	71.92	2.90	71.46
2WMW44DS	73.72	2.29	71.43	1.62	72.10	2.00	71.72
2WMW45DS	74.24	2.95	71.29	2.12	72.12	2.60	71.64
2WMW46DS	73.53	2.28 *	71.25	1.55 *	71.98	1.97	71.56
2WMW47DS	73.39	2.37	71.02	1.38	72.01	1.75	71.64
2LMW29A[1]	91.37	--		--		8.91	82.46
2LMW29F[1]	91.50	--		--		10.56	80.94
2LMW7S[1]	84.87	--		--		11.85	73.02
2LMW7D[1]	85.74	--		--		6.65	79.09
2LMW32F[1]	84.52	--		--		13.18	71.34
2LMW32DS[1]	84.17	--		--		12.57	71.60
2LMW32B[1]	84.81	--		--		12.21	72.60

1 No water levels were taken in these wells during Rounds 9 and 10.
2 Elevations based on Base 1982 Vertical Datum.
3 Water level measured in December 2002.

TABLE 3-1

MONITORING WELL CONSTRUCTION AND ROUND 4 WATER LEVEL INFORMATION
YEAR 1 ANNUAL GROUNDWATER MONITORING REPORT FOR SITES 3 AND 7
NSB-NLON, GROTON, CONNECTICUT

Monitoring Well	Northing [1]	Easting [1]	Ground Surface Elev (ft) [2]	Top of Casing Elev (ft) [2]	Top of Riser Elev (ft) [2]	Screened Aquifer	Screen Top Depth (ft)	Screen Bottom Depth (ft)	Screen Top Elev (ft) [2]	Screen Bottom Elev (ft) [2]	Depth to Water (ft)[3]	Groundwater Elevation (ft)[3]
Site 3												
2DMW16S	708522.1	1181411.1	33.21	35.69	35.46	Overburden (Alluvium)	1.69	11.69	31.52	21.52	3.87	31.59
2DMW16D	708531.9	1181404.8	33.51	35.30	NA	Bedrock	18.00	59.91	15.51	-26.40	3.72 *	31.58
2DMW25S	708649.4	1180952.5	31.09	33.02	32.59	Overburden (Fill)	5.50	10.50	25.59	20.59	6.80	25.79
2DMW28D	708835.6	1180594.4	33.22	33.22	33.01	Bedrock	26.00	136.00	7.22	-102.78	16.11	16.90
2DMW29S	709579.0	1181082.1	32.59	34.47	34.29	Overburden (Alluvium)	6.00	16.00	26.59	16.59	8.57 *	25.72
3MW15S	709329.6	1180638.3	33.20	33.24	32.86	Overburden (Alluvium)	28.00	38.00	5.20	-4.80	29.38 *	3.48
3MW15I	709351.2	1180640.8	33.50	33.53	33.10	Overburden (Alluvium)	55.50	65.50	-22.00	-32.00	30.85 *	2.25
3MW16S	709908.8	1180730.0	36.10	36.10	35.78	Bedrock	17.00	27.00	19.10	9.10	14.36 *	21.42
3MW16D	709899.8	1180723.2	36.20	36.19	35.80	Bedrock	59.00	69.00	-22.80	-32.80	22.12 *	13.68
Site 7												
7MW1D	709291.1	1182145.8	52.28	NA	51.69	Bedrock	14.20	25.20	38.08	27.08	8.98	42.71
7MW3S	709033.9	1181704.2	43.59	43.59	43.32	Overburden (Fill/Alluvium)	6.90	16.90	36.69	26.69	5.60	37.72
7MW3I	709021.9	1181707.0	43.40	45.38	45.21	Overburden (Alluvium)	22.50	32.50	20.90	10.90	7.35	37.86
7MW5D	709280.3	1181887.3	54.43	54.43	54.18	Bedrock	32.00	42.00	22.43	12.43	12.40 *	41.78
7MW9S	709177.8	1181377.0	35.80	35.77	35.40	Overburden (Alluvium)	4.00	14.00	31.81	21.81	3.86	31.54
7MW12S	709075.9	1181805.7	44.10	44.13	43.62	Overburden (Fill/Alluvium)	3.50	13.50	40.60	30.60	3.26	40.36
7MW12I	709070.3	1181808.8	44.20	44.22	43.90	Overburden (Alluvium)	20.00	30.00	24.20	14.20	4.97 *	38.93
7MW13S	708891.7	1181882.7	48.60	50.79	50.58	Overburden (Fill/Alluvium)	6.50	16.50	42.10	32.10	8.91	41.67

1 North American Datum (NAD) 83, Connecticut State Plane Coordinate System

2 North American Vertical Datum (NAVD) 88 (NAVD 88 = 1982 Base Vertical Datum - 2.39 feet[3]). Vertical datum conversion factor of 2.39 feet was provided by NSB-NLON Public Works Department.

3 Water levels were measured on March 17th and 18th, 2007.

NA - Not available

Elev - Elevation

ft - Feet

TABLE 2-2

WATER LEVEL MEASUREMENTS AND ELEVATIONS
OCTOBER 2002 DGI
BASEWIDE GROUNDWATER OU RI UPDATE/FS
NSB-NLON, GROTON, CONNECTICUT

Well Name	Depth to Top of Monitored Interval (feet bgs)	Depth to Bottom of Monitored Interval (feet bgs)	Reference Point Elevation[1] (feet)	Reference Point Elevation[2] (feet)	Well Diameter (inches)	Aquifer Monitored	October 2002 Depth to Water (feet)	October 2002 Water Elevation[2] (feet)
SITES 3/14								
2DMW10D	10.00	26.09	54.52	52.13	6	BEDROCK	10.13	42.00
2DMW11D	19.50	25.50	53.20	50.81	6	BEDROCK	NM[3]	NA
2DMW11S	2.50	12.50	46.85	44.46	2	OVERBURDEN (ALLUVIUM)	2.09	42.37
2DMW15D	10.00	19.51	44.09	41.70	6	BEDROCK	7.32	34.38
2DMW16D	18.00	59.91	37.69	35.30	6	BEDROCK	5.28	30.02
2DMW16S	1.69	11.69	37.85	35.46	2	OVERBURDEN (ALLUVIUM)	5.85	29.61
2DMW23D	7.50	65.00	83.38	80.99	6	BEDROCK	30.41	50.58
2DMW24D	25.00	45.00	36.07	33.68	6	BEDROCK	4.65	29.03
2DMW24S	4.00	14.00	36.29	33.90	2	OVERBURDEN (ALLUVIUM)	NM[4]	NA
2DMW25D	18.00	40.00	35.48	33.09	6	BEDROCK	8.48	24.61
2DMW25S	5.50	10.50	34.98	32.59	2	OVERBURDEN (FILL)	8.12	24.47
2DMW26D	30.00	40.00	29.19	26.80	2	OVERBURDEN (ALLUVIUM))	10.51	16.29
2DMW26S	8.00	18.00	28.71	26.32	2	OVERBURDEN (ALLUVIUM)	6.63	19.69
2DMW27D	20.00	205.00	27.95	25.56	6	BEDROCK	12.96	12.60
2DMW28D	26.00	136.00	35.40	33.01	6	BEDROCK	16.95	16.06
2DMW28S	17.00	22.00	35.26	32.87	2	OVERBURDEN (ALLUVIUM)	18.23	14.64
2DMW29S	6.00	16.00	36.68	34.29	2	OVERBURDEN (ALLUVIUM)	9.11	25.18
2DMW30S	4.00	9.00	33.11	30.72	2	OVERBURDEN (ALLUVIUM)	7.35	23.37
3MW12D	20.00	25.00	47.22	44.83	2	BEDROCK	4.44	40.39[5]
3MW14S	28.00	38.00	36.81	34.42	2	OVERBURDEN (ALLUVIUM)	32.16	2.26
14MW1S	4.00	14.00	51.54	49.05	2	OVERBURDEN (ALLUVIUM)	5.01	44.04
3TW27	1.00	6.00	38.20	35.81	1	OVERBURDEN (ALLUVIUM)	5.86	29.95
3TW28	1.70	6.70	39.56	37.17	1	OVERBURDEN (ALLUVIUM)	7.12	30.05
3TW29	3.00	7.50	38.96	36.57	1	OVERBURDEN (ALLUVIUM)	8.78	27.79
3TW30	6.00	16.00	37.81	35.42	1	OVERBURDEN (ALLUVIUM)	8.13	27.29
SITE 7								
7MW10S	4.00	14.00	43.42	41.03	2	OVERBURDEN (ALLUVIUM)	12.25	28.78
7MW3D	23.80	33.80	46.67	44.28	2	OVERBURDEN (ALLUVIUM)	8.90	35.38
SITE 20								
2WCMW1S	8.00	18.00	83.92	81.53	2	OVERBURDEN (FILL/DREDGE)	12.10	69.43
2WCMW2S	4.00	14.00	86.16	83.77	2	OVERBURDEN (FILL)	4.57	79.20
2WCMW3S	5.75	15.75	85.95	83.56	2	OVERBURDEN (FILL/DREDGE)	10.03	73.53
2WMW4D	13.00	119.40	92.69	90.30	6	BEDROCK	6.14	84.16
SITE 15								
15MW1D	36.00	46.00	28.05	25.66	2	OVERBURDEN (ALLUVIUM)	10.24	15.42
15MW1S	5.00	15.00	28.08	25.69	2	OVERBURDEN (ALLUVIUM)	7.02	18.67
15MW2S	5.00	15.00	28.90	26.51	2	OVERBURDEN (ALLUVIUM)	7.82	18.69
15MW3S	5.00	15.00	26.26	23.87	2	OVERBURDEN (ALLUVIUM)	5.81	18.06
15TW01	5.00	15.00	29.62	27.23	1	OVERBURDEN (ALLUVIUM)	8.45	18.78
15TW02	5.00	15.00	29.09	26.70	1	OVERBURDEN (ALLUVIUM)	7.98	18.72
15TW03	5.00	15.00	27.52	25.13	1	OVERBURDEN (ALLUVIUM)	6.49	18.64

Notes:
1 Elevation based on Base 1982 Vertical Datum.
2 Elevation based on NAVD 1988.
3 A water level measurement could not be taken at monitoring well 2DMW24S because it could not be located. It was assumed to have been destroyed.
4 A water level measurement could not be taken at monitoring well 2DMW11D because it was destroyed.
5 Measured on 12/04/02.

bgs = Below ground surface.
NA = Not applicable.
NM = No Measurement.

TABLE 2-2

WATER TABLE ELEVATION SUMMARY - JUNE 2000
BASEWIDE GROUNDWATER OU RI
NSB-NLON, GROTON, CONNECTICUT

Well Name	Depth to Top of Screen (Feet)	Depth to Bottom of Screen (Feet)	Top of Casing Elevation 1982 Datum	Top of Casing Elevation 1988 Datum	Well Diameter	Aquifer Monitored	Depth to Water (feet) June 2000	Water Elevation (ft-msl)* June 2000
7MW4S	4.00	14.00	46.84	44.45	2	BEDROCK	2.08	42.37
7MW5D	32.00	42.00	56.57	54.18	2	BEDROCK	11.84	42.34
7MW5S	7.00	17.00	56.62	54.23	2	OVERBURDEN (ALLUVIUM)/ BEDROCK	11.9	42.33
7MW6S	4.00	14.00	46.65	44.26	2	OVERBURDEN (ALLUVIUM)	3.97	40.29
7MW7S	5.50	15.50	46.57	44.18	2	BEDROCK	1.87	42.31
7MW8S	3.00	13.00	42.10	39.71	2	OVERBURDEN (ALLUVIUM)	3.81	35.90
7MW9S	4.00	14.00	37.91	35.52	2	OVERBURDEN (ALLUVIUM)	4.48	31.04
B325-MW1	3.00	13.00	47.23	44.84	2	OVERBURDEN/BEDROCK	2.53	42.31
B325-MW3	2.50	12.50	46.05	43.66	2	OVERBURDEN	1.24	42.42
B325-MW4	4.00	14.00	46.88	44.49	2	OVERBURDEN	3.42	41.07
SOUTHERN REGION WELLS								
8MW1	6.40	16.40	10.15	7.76	2	OVERBURDEN (FILL)	8.37	-0.61
8MW2D	54.00	64.00	9.77	7.38	2	OVERBURDEN (ALLUVIUM)	7.18	0.20
8MW2S	5.90	15.90	9.43	7.04	2	OVERBURDEN (FILL)	6.52	0.52
8MW3	5.80	15.80	8.96	6.57	2	OVERBURDEN (FILL)	6.09	0.48
8MW4	5.40	14.40	9.34	6.95	2	OVERBURDEN (FILL)	6.14	0.81
8MW5S	6.00	16.00	10.94	8.55	2	OVERBURDEN (FILL)	9.03	-0.48
8MW6D	60.00	70.00	9.62	7.23	2	OVERBURDEN (ALLUVIUM)	7.15	0.08
8MW6S	4.00	14.00	9.66	7.27	2	OVERBURDEN (FILL)	6.43	0.84
8MW8D	48.00	78.00	19.53	17.14	2	BEDROCK	16.58	0.56
8MW8S	7.00	17.00	19.68	17.29	2	OVERBURDEN (ALLUVIUM)/ BEDROCK	14.67	2.62
15MW1D	36.00	46.00	28.05	25.66	2	OVERBURDEN (ALLUVIUM)	9.22	16.44
15MW1S	5.00	15.00	28.08	25.69	2	OVERBURDEN (ALLUVIUM)	3.87	21.82
15MW2S	5.00	15.00	28.90	26.51	2	OVERBURDEN (ALLUVIUM)	4.61	21.90
15MW3S	5.00	15.00	26.26	23.87	2	OVERBURDEN (ALLUVIUM)	4.38	19.49
23MW01D	50.00	56.50	36.83	34.44	2	BEDROCK	3.85	30.59
23MW02D	18.60	28.50	23.19	20.80	8	BEDROCK	3.72	17.08
23MW03D	39.00	55.00	22.91	20.52	8	BEDROCK	1.1	19.42
ERM-1	3.54	13.04	22.49	20.10	2	OVERBURDEN (FILL)	4.25	15.85
ERM-13	5.50	14.55	25.52	23.13	2	OVERBURDEN (FILL)	6.02	17.11
ERM-14	5.50	14.28	25.21	22.82	2	OVERBURDEN (FILL)	5.69	17.13
ERM-15	2.25	11.25	22.63	20.24	2	OVERBURDEN (FILL)	3.46	16.78
ERM-17	2.72	11.72	22.15	19.76	2	OVERBURDEN (FILL)	4.09	15.67
ERM-19	2.81	11.81	22.03	19.64	2	OVERBURDEN (FILL)	4.13	15.51
ERM-2	3.71	13.21	21.46	19.07	2	OVERBURDEN (FILL)	3.81	15.26
HNUS-10	5.00	15.00	23.25	20.86	2	OVERBURDEN (FILL)	8.81	12.05
HNUS-11	5.00	15.00	22.23	19.84	2	OVERBURDEN (FILL)	8.63	11.21
HNUS-12	5.00	15.00	26.47	24.08	2	OVERBURDEN (FILL)	2.68	21.40
HNUS-13	5.00	15.00	25.71	23.32	2	OVERBURDEN (FILL)	1.22	22.10
HNUS-15	5.00	15.00	23.13	20.74	2	OVERBURDEN (FILL)	4.94	15.80
HNUS-2	4.00	14.00	20.70	18.31	2	OVERBURDEN (FILL)	4.82	13.49
HNUS-21	5.00	15.00	22.35	19.96	2	OVERBURDEN (FILL)	7	12.96
HNUS-22	10.00	20.00	27.70	25.31	2	OVERBURDEN (FILL)	9.78	15.53
HNUS-23	7.00	17.00	20.42	18.03	2	OVERBURDEN (FILL)	6.93*	11.10
HNUS-24	5.00	15.00	27.11	24.72	2	OVERBURDEN (FILL)	10.71	14.01
HNUS-4	4.00	14.00	21.24	18.85	2	OVERBURDEN (FILL)	4.32	14.53
HNUS-5	4.00	14.00	21.35	18.96	2	OVERBURDEN (FILL)	4.22	14.74
LOWER SUBASE WELLS								
6MW1S	4.00	14.00	8.63	6.24	2	OVERBURDEN (FILL)	5.9	0.34
6MW2D	77.00	87.00	7.85	5.46	2	OVERBURDEN (ALLUVIUM)	4.51	0.95
6MW2S	3.20	13.20	7.30	4.91	2	OVERBURDEN (FILL/DREDGE)	4.5	0.41
6MW6D	28.00	42.00	12.50	10.11	6	BEDROCK	8.99	1.12
6MW6S	6.00	16.00	12.16	9.77	2	OVERBURDEN (FILL)	8.65	1.12
13MW12	5.30	15.30	9.21	6.82	2	OVERBURDEN (FILL)	6.34	0.48
13MW14	4.80	14.80	7.98	5.59	2	OVERBURDEN (FILL)	5.02	0.57

TABLE 2-3

SUMMARY OF WATER ELEVATIONS - AUGUST 2000
BASEWIDE GROUNDWATER OU RI
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 3

Well Name	Depth to Top of Screen (Feet)	Depth to Bottom of Screen (Feet)	Top of Casing Elevation 1982 Datum	Top of Casing Elevation 1988 Datum	Well Diameter	Aquifer Monitored	Depth to Water (feet) August 2000	Water Elevation (ft-msl)* August 2000
7MW7S	5.50	15.50	46.57	44.18	2	BEDROCK	2.45	41.73
7MW8S	3.00	13.00	42.10	39.71	2	OVERBURDEN (ALLUVIUM)	5.84	33.87
7MW9S	4.00	14.00	37.91	35.52	2	OVERBURDEN (ALLUVIUM)	5.88	29.64
B325-MW1	3.00	13.00	47.23	44.84	2	OVERBURDEN/BEDROCK	3.15	41.69
B325-MW3	2.50	12.50	46.05	43.66	2	OVERBURDEN	1.87	41.79
B325-MW4	4.00	14.00	46.88	44.49	2	OVERBURDEN	4.07	40.42
14MW1S	4.00	14.00	51.44	49.05	2	OVERBURDEN (ALLUVIUM)	5.32	43.73
SOUTHERN REGION WELLS								
8MW1	6.40	16.40	10.15	7.76	2	OVERBURDEN (FILL)	8.70	-0.94
8MW10S	14.50	21.50	21.61	19.22	2	BEDROCK	16.35	2.87
8MW2D	54.00	64.00	9.77	7.38	2	OVERBURDEN (ALLUVIUM)	7.65	-0.27
8MW2S	5.90	15.90	9.43	7.04	2	OVERBURDEN (FILL)	7.03	0.01
8MW3	5.80	15.80	8.96	6.57	2	OVERBURDEN (FILL)	6.53	0.04
8MW4	5.40	14.40	9.34	6.95	2	OVERBURDEN (FILL)	6.67	0.28
8MW5S	6.00	16.00	10.94	8.55	2	OVERBURDEN (FILL)	9.30	-0.75
8MW6D	60.00	70.00	9.62	7.23	2	OVERBURDEN (ALLUVIUM)	7.70	-0.47
8MW6S	4.00	14.00	9.66	7.27	2	OVERBURDEN (FILL)	6.96	0.31
8MW8D	48.00	78.00	19.53	17.14	2	BEDROCK	16.81	0.33
8MW8S	7.00	17.00	19.68	17.29	2	OVERBURDEN (ALLUVIUM)/ BEDROCK	15.24	2.05
8MW9S	14.00	19.00	21.40	19.01	2	BEDROCK	15.93	3.08
15MW1D	36.00	46.00	28.05	25.66	2	OVERBURDEN (ALLUVIUM)	9.98	15.68
15MW1S	5.00	15.00	28.08	25.69	2	OVERBURDEN (ALLUVIUM)	5.58	20.11
15MW2S	5.00	15.00	28.90	26.51	2	OVERBURDEN (ALLUVIUM)	6.36	20.15
15MW3S	5.00	15.00	26.26	23.87	2	OVERBURDEN (ALLUVIUM)	4.49	19.38
23MW01D	50.00	56.50	36.83	34.44	2	BEDROCK	4.65	29.79
23MW01S	6.00	16.00	37.25	34.86	2	OVERBURDEN (ALLUVIUM)	6.64	28.22
23MW02D	18.60	28.50	23.19	20.80	8	BEDROCK	6.11	14.69
23MW02S	4.00	14.00	23.35	20.96	2	OVERBURDEN (ALLUVIUM)	6.09	14.87
23MW03D	39.00	55.00	22.91	20.52	8	BEDROCK	7.19	13.33
23MW04D	65.50	95.50	21.89	19.50	2	BEDROCK	7.44	12.06
23MW04S	45.00	55.00	21.56	19.17	2	OVERBURDEN (ALLUVIUM)	8.11	11.06
HNUS-11	5.00	15.00	22.23	19.84	2	OVERBURDEN (FILL)	8.88	10.96
HNUS-13	5.00	15.00	25.71	23.32	2	OVERBURDEN (FILL)	4.51	18.81
HNUS-2	4.00	14.00	20.70	18.31	2	OVERBURDEN (FILL)	5.47	12.84
HNUS-20	5.00	15.00	22.51	20.12	2	OVERBURDEN (FILL)	8.24	11.88
HNUS-23	7.00	17.00	20.42	18.03	2	OVERBURDEN (FILL)	8.89*	9.14
LOWER SUBASE WELLS								
FOMW14	3.20	10.20	12.68	10.29	2	OVERBURDEN(FILL/ALLUVIUM)	9.35	0.94
MW1-7RI	5.00	9.00	8.11	5.72	2	OVERBURDEN(FILL)	5.50	0.22
MW2-3RI	3.00	8.00	7.78	5.39	2	OVERBURDEN(FILL)	5.94	-0.55
MW2-6RI	3.00	8.00	6.02	3.63	2	OVERBURDEN(FILL)	3.00	0.63
MW3-6RI	3.00	8.00	6.31	3.92	2	OVERBURDEN(FILL)	3.31	0.61
MW3-7RI	3.00	8.00	6.66	4.27	2	OVERBURDEN(FILL)	3.88	0.39
MW4-6RI	3.00	8.00	6.90	4.51	2	OVERBURDEN(FILL)	3.92	0.59
MW4-7RI	3.00	8.00	8.06	5.67	2	OVERBURDEN(FILL)	5.50	0.17
NESO10	4.30	9.30	8.10	5.71	2	OVERBURDEN (ALLUVIUM)	6.02	-0.31
13MW1	7.49	17.49	13.36	10.97	2	OVERBURDEN (ALLUVIUM)	10.11	0.86
13MW10	5.00	15.00	8.44	6.05	2	OVERBURDEN (ALLUVIUM)	6.12	-0.07
13MW12	5.30	15.30	9.21	6.82	2	OVERBURDEN (FILL)	6.38	0.44
13MW14	4.80	14.80	7.98	5.59	2	OVERBURDEN (FILL)	6.60	-1.01
13MW19	5.00	15.00	8.05	5.66	2	OVERBURDEN (FILL)	4.58	1.08
13MW2	7.67	17.67	12.80	10.41	2	OVERBURDEN (ALLUVIUM)	9.49	0.92
13MW20	3.00	13.00	10.45	8.06	2	OVERBURDEN (FILL)	7.12	0.94
13MW21	5.00	15.00	8.70	6.31	2	OVERBURDEN (FILL)	5.33	0.98
13MW3	7.36	17.36	12.89	10.50	2	OVERBURDEN (ALLUVIUM)	9.85	0.65

APPENDIX B.6

SITE 7 - TORPEDO SHOPS SOIL DATA

SUMMARY OF SITE 3 SOIL DATA -AREA A DOWNSTREAM
BASEWIDE GROUDWATER OPERABLE UNIT REMEDIAL INVESTIGATION
NSB-NLON, GRORON, CONNECTICUT

location	3SB14S3	3SB29D0	3SB29D1
matrix	SB	SB	SB
sample	S3SB14S3234	S3SB29D0911	S3SB29D1012
depth	32-34	09-11	10-12
sample_date	6/22/00	6/13/00	6/23/00
validated	TRUE	TRUE	TRUE
cto_proj	312	312	312
proj_manager	CERCONE, D.	CERCONE, D.	CERCONE, D.
Grain Size (%)			
SIEVE # 10		100	
SIEVE # 100		94.44	
SIEVE # 200		66.05	
SIEVE # 4		100	
SIEVE # 40		99.07	
SIEVE # 50		98.61	
SIEVE 1-1/2"		100	
SIEVE 1/2"		100	
SIEVE 3"		100	
SIEVE 3/4"		100	
SIEVE 3/8"		100	
Miscellaneous Parameters			
BULK DENSITY (LB/CU FT)		112.22	
PH		6.96	
POROSITY (N)		0.3306	
SPECIFIC GRAVITY		2.69	
TOTAL ORGANIC CARBON (MG/KG)	109 U		123 U

$112.22 \frac{lb}{ft^3} \Rightarrow 1.8 \frac{g}{cm^3}$

$\left[\text{CONV. FACTOR} = 0.016 \right]$

APPENDIX B.2

SITE 3 - AREA A DOWNSTREAM SOIL DATA

SUMMARY OF SITE 7 SOIL DATA - TORPEDO SHOPS
BASEWIDE GROUNDWATER OPERABLE UNIT REMEDIAL INVESTIGATION
NSB-NLON, GROTON, CONNECTICUT

location	7SB01
matrix	SB
sample	S7SB010912
sacode	NORMAL
depth	09-12
sample_date	6/13/00
validated	TRUE
cto_proj	312
proj_manager	CERCONE, D.
Grain Size (%)	
SIEVE # 10	35.38
SIEVE # 100	27.44
SIEVE # 200	19.49
SIEVE # 4	45.71
SIEVE # 40	30.99
SIEVE # 50	29.82
SIEVE 1-1/2"	100
SIEVE 1/2"	63.77
SIEVE 3"	100
SIEVE 3/4"	100
SIEVE 3/8"	58.69
Miscellaneous Parameters	
BULK DENSITY (LB/FT)	98.77
PH	8.33
POROSITY(N)	0.3736
SPECIFIC GRAVITY	2.53

$98.77 \frac{lb}{ft^3} \Rightarrow 1.58 = 1.6 \ g/cm^3$

$\left[\text{CONV. FACTOR} = 0.016\right]$

APPENDIX B.17

SITE 23 - TANK FARM SOIL DATA

SUMMARY OF SITE 23 SOIL DATA
TANK FARM
BASEWIDE GROUNDWATER OPERABLE UNIT REMEDIAL INVESTIGATION
NSB-NLON, GROTON, CONNECTICUT

site	23	23
location	23SB02S	23SB04S
matrix	SB	SB
sample	S23SB02S0810	S23SB04S1012
depth	08-10	10-12
sample_date	6/13/00	6/13/00
validated	TRUE	TRUE
cto_proj	312	312
proj_manager	CERCONE, D.	CERCONE, D.
Grain Size (%)		
SIEVE # 10	87.69	97.51
SIEVE # 100	40.62	39.98
SIEVE # 200	25.12	17.01
SIEVE # 4	92.55	98.70
SIEVE # 40	65.74	87.00
SIEVE # 50	57.20	79.31
SIEVE 1-1/2"	100	100
SIEVE 1/2"	98.41	100
SIEVE 3"	100	100
SIEVE 3/4"	100	100
SIEVE 3/8"	97.22	99.57
Miscellaneous Parameters		
BULK DENSITY (LB/CU FT)	90.83	90.75
PH	5.96	7.46
SPECIFIC GRAVITY	2.54	2.68
TOTAL ORGANIC CARBON (MG/KG)	125 U	126 U
POROSITY (N)	0.4263	0.4567

$90.8 \frac{lb}{ft^3} \Rightarrow 1.5 \frac{g}{cm^3}$

[CONV. FACTOR = 0.016]

ATTACHMENT B

VAPOR INTRUSION MODELING PRINTOUTS

SITE 2

AREA A UPGRADIENT

RESIDENTIAL

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
67663	1.00E+00	Chloroform

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	190	190	0	0	A	SL	SL		

Note: Thickness columns (stratum A, B, C): Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SL	1.80	0.330	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	3.98E+01	7.92E+03	2.3E-05	4.9E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	175	0.227	0.321	0.321	0.220	5.94E-09	0.879	5.22E-09	25.00	0.33	0.010	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	7,544	1.95E-03	8.38E-02	1.76E-04	6.85E-03	0.00E+00	0.00E+00	2.48E-05	1.70E-04	175

Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
15	8.38E+01	0.10	8.33E+01	6.85E-03	4.00E+02	1.29E+132	6.00E-05	5.03E-03	2.3E-05	4.9E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	7.92E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
4.8E-08	9.8E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
2.10E+01	1.02E+04	2.10E+01	7.92E+06	2.10E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
79016	9.00E-01	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
			Totals must add up to value of L_{WT} (cell G28)							
11	15	190	190	0	0	A	SL	SL		

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
Lookup Soil Parameters				Lookup Soil Parameters				Lookup Soil Parameters			
SL	1.80	0.330	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	175	0.227	0.321	0.321	0.220	5.94E-09	0.879	5.22E-09	25.00	0.33	0.010	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	5.20E-03	0.00E+00	0.00E+00	8.83E-06	6.12E-05	175

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.95E+02	0.10	8.33E+01	5.20E-03	4.00E+02	8.41E+173	2.18E-05	4.24E-03	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.9E-07	1.2E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
4.69E+00	7.74E+03	4.69E+00	1.47E+06	4.69E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	9.00E-01	*Trichloroethylene*

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
			Totals must add up to value of L_{WT} (cell G28)							
11	15	190	190	0	0	A	SL	SL		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SL	1.80	0.330	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	175	0.227	0.321	0.321	0.220	5.94E-09	0.879	5.22E-09	25.00	0.33	0.010	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	5.20E-03	0.00E+00	0.00E+00	8.83E-06	6.12E-05	175

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.95E+02	0.10	8.33E+01	5.20E-03	4.00E+02	8.41E+173	2.18E-05	4.24E-03	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
3.5E-09	6.8E-06

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
2.58E+02	1.33E+05	2.58E+02	1.47E+06	2.58E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

INDUSTRIAL

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
67663	1.00E+00	Chloroform

MORE ↓

ENTER Average soil/groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
			Totals must add up to value of L_{WT} (cell G28)							
11	15	190	190	0	0	A	SL	SL		

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
Lookup Soil Parameters				Lookup Soil Parameters				Lookup Soil Parameters			
SL	1.80	0.330	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	3.98E+01	7.92E+03	2.3E-05	4.9E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	175	0.227	0.321	0.321	0.220	5.94E-09	0.879	5.22E-09	25.00	0.33	0.010	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	7,544	1.95E-03	8.38E-02	1.76E-04	6.85E-03	0.00E+00	0.00E+00	2.48E-05	1.70E-04	175

Convection path length, L_p (cm)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF (µg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
15	8.38E+01	0.10	8.33E+01	6.85E-03	4.00E+02	1.29E+132	1.47E-05	1.23E-03	2.3E-05	4.9E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	7.92E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
6.9E-09	1.7E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
1.44E+02	5.81E+04	1.44E+02	7.92E+06	1.44E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	5.00E-01	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	190	190	0	0	A	SL	SL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SL	1.80	0.330	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	175	0.227	0.321	0.321	0.220	5.94E-09	0.879	5.22E-09	25.00	0.33	0.010	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	5.20E-03	0.00E+00	0.00E+00	8.83E-06	6.12E-05	175

Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
15	1.08E+02	0.10	8.33E+01	5.20E-03	4.00E+02	8.41E+173	5.34E-06	5.78E-04	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.6E-08	1.1E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
3.22E+01	4.42E+04	3.22E+01	1.47E+06	3.22E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	9.00E-01	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	190	190	0	0	A	SL	SL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SL	1.80	0.330	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	175	0.227	0.321	0.321	0.220	5.94E-09	0.879	5.22E-09	25.00	0.33	0.010	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	5.20E-03	0.00E+00	0.00E+00	8.83E-06	6.12E-05	175

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.95E+02	0.10	8.33E+01	5.20E-03	4.00E+02	8.41E+173	5.34E-06	1.04E-03	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
5.1E-10	1.2E-06

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
1.77E+03	7.58E+05	1.77E+03	1.47E+06	1.77E+03

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

SITE 2

AREA A DOWNSTREAM

RESIDENTIAL

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
79016	2.00E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	110	110	0	0	A	SL	SL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SL	1.80	0.330	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm³/cm³)	Stratum B soil air-filled porosity, θ_a^B (cm³/cm³)	Stratum C soil air-filled porosity, θ_a^C (cm³/cm³)	Stratum A effective total fluid saturation, S_{te} (cm³/cm³)	Stratum A soil intrinsic permeability, k_i (cm²)	Stratum A soil relative air permeability, k_{rg} (cm²)	Stratum A soil effective vapor permeability, k_v (cm²)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm³/cm³)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	95	0.227	0.321	0.321	0.220	5.94E-09	0.879	5.22E-09	25.00	0.33	0.010	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm³/s)	Area of enclosed space below grade, A_B (cm²)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m³/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm²/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm²/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm²/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm²/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm²/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	5.20E-03	0.00E+00	0.00E+00	8.83E-06	3.34E-05	95

Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm³/s)	Crack effective diffusion coefficient, D^{crack} (cm²/s)	Area of crack, A_{crack} (cm²)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m³)	Unit risk factor, URF (μg/m³)⁻¹	Reference conc., RfC (mg/m³)
15	4.33E+02	0.10	8.33E+01	5.20E-03	4.00E+02	8.41E+173	2.19E-05	9.48E-03	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
4.3E-07	2.6E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
4.67E+00	7.70E+03	4.67E+00	1.47E+06	4.67E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	2.00E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
11	15	110	110	0	0	A	SL	SL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SL	1.80	0.330	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	95	0.227	0.321	0.321	0.220	5.94E-09	0.879	5.22E-09	25.00	0.33	0.010	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	5.20E-03	0.00E+00	0.00E+00	8.83E-06	3.34E-05	95

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	4.33E+02	0.10	8.33E+01	5.20E-03	4.00E+02	8.41E+173	2.19E-05	9.48E-03	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure *component* water solubility, S (µg/L)	Final *indoor* exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
7.8E-09	1.5E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
2.57E+02	1.32E+05	2.57E+02	1.47E+06	2.57E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

INDUSTRIAL

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	2.00E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	110	110	0	0	A	SL	SL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SL	1.80	0.330	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	95	0.227	0.321	0.321	0.220	5.94E-09	0.879	5.22E-09	25.00	0.33	0.010	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	5.20E-03	0.00E+00	0.00E+00	8.83E-06	3.34E-05	95

Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
15	4.33E+02	0.10	8.33E+01	5.20E-03	4.00E+02	8.41E+173	5.36E-06	2.32E-03	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
6.3E-08	4.5E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
3.20E+01	4.40E+04	3.20E+01	1.47E+06	3.20E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	2.00E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	110	110	0	0	A	SL	SL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SL	1.80	0.330	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	95	0.227	0.321	0.321	0.220	5.94E-09	0.879	5.22E-09	25.00	0.33	0.010	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	5.20E-03	0.00E+00	0.00E+00	8.83E-06	3.34E-05	95

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
15	4.33E+02	0.10	8.33E+01	5.20E-03	4.00E+02	8.41E+173	5.36E-06	2.32E-03	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.1E-09	2.7E-06

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
1.76E+03	7.54E+05	1.76E+03	1.47E+06	1.76E+03

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

SITE 2

AREA A WETLANDS

RESIDENTIAL

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
127184	1.40E+00	Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	65	65	0	0	A	CL	CL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
CL	1.48	0.442	0.168	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.20E-02	8.20E-06	1.84E-02	25	8,288	394.40	620.20	1.55E+02	2.00E+02	5.9E-06	2.8E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	50	0.274	0.321	0.321	0.245	1.26E-09	0.865	1.09E-09	46.88	0.442	0.067	0.375	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	9,543	8.30E-03	3.56E-01	1.76E-04	4.95E-03	0.00E+00	0.00E+00	4.97E-05	5.29E-05	50

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	4.98E+02	0.10	8.33E+01	4.95E-03	4.00E+02	8.79E+182	6.54E-05	3.26E-02	5.9E-06	2.8E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	2.00E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
7.9E-08	1.1E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
1.77E+01	1.26E+04	1.77E+01	2.00E+05	1.77E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	1.40E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	65	65	0	0	A	CL	CL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
CL	1.48	0.442	0.168	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	50	0.274	0.321	0.321	0.245	1.26E-09	0.865	1.09E-09	46.88	0.442	0.067	0.375	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	5.43E-03	0.00E+00	0.00E+00	5.78E-05	6.16E-05	50

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	3.03E+02	0.10	8.33E+01	5.43E-03	4.00E+02	5.33E+166	7.59E-05	2.30E-02	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.0E-06	6.3E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
1.35E+00	2.22E+03	1.35E+00	1.47E+06	1.35E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	1.40E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
11	15	65	65	0	0	A	CL	CL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
CL	1.48	0.442	0.168	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	50	0.274	0.321	0.321	0.245	1.26E-09	0.865	1.09E-09	46.88	0.442	0.067	0.375	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	5.43E-03	0.00E+00	0.00E+00	5.78E-05	6.16E-05	50

Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
15	3.03E+02	0.10	8.33E+01	5.43E-03	4.00E+02	5.33E+166	7.59E-05	2.30E-02	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.9E-08	3.7E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
7.41E+01	3.81E+04	7.41E+01	1.47E+06	7.41E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

INDUSTRIAL

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
127184	1.40E+00	Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	65	65	0	0	A	CL	CL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
CL	1.48	0.442	0.168	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.20E-02	8.20E-06	1.84E-02	25	8,288	394.40	620.20	1.55E+02	2.00E+02	5.9E-06	2.8E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm³/cm³)	Stratum B soil air-filled porosity, θ_a^B (cm³/cm³)	Stratum C soil air-filled porosity, θ_a^C (cm³/cm³)	Stratum A effective total fluid saturation, S_{te} (cm³/cm³)	Stratum A soil intrinsic permeability, k_i (cm²)	Stratum A soil relative air permeability, k_{rg} (cm²)	Stratum A soil effective vapor permeability, k_v (cm²)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm³/cm³)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	50	0.274	0.321	0.321	0.245	1.26E-09	0.865	1.09E-09	46.88	0.442	0.067	0.375	4,000

Bldg. ventilation rate, $Q_{building}$ (cm³/s)	Area of enclosed space below grade, A_B (cm²)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m³/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm²/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm²/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm²/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm²/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm²/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	9,543	8.30E-03	3.56E-01	1.76E-04	4.95E-03	0.00E+00	0.00E+00	4.97E-05	5.29E-05	50

Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm³/s)	Crack effective diffusion coefficient, D^{crack} (cm²/s)	Area of crack, A_{crack} (cm²)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m³)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m³)
15	4.98E+02	0.10	8.33E+01	4.95E-03	4.00E+02	8.79E+182	1.60E-05	7.98E-03	5.9E-06	2.8E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	2.00E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.2E-08	2.0E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
1.22E+02	7.17E+04	1.22E+02	2.00E+05	1.22E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
79016	1.40E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	65	65	0	0	A	CL	CL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
CL	1.48	0.442	0.168	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	50	0.274	0.321	0.321	0.245	1.26E-09	0.865	1.09E-09	46.88	0.442	0.067	0.375	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	5.43E-03	0.00E+00	0.00E+00	5.78E-05	6.16E-05	50

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	3.03E+02	0.10	8.33E+01	5.43E-03	4.00E+02	5.33E+166	1.86E-05	5.63E-03	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.5E-07	1.1E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
9.24E+00	1.27E+04	9.24E+00	1.47E+06	9.24E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	1.40E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
			Totals must add up to value of L_{WT} (cell G28)							
11	15	65	65	0	0	A	CL	CL		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
CL	1.48	0.442	0.168	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	50	0.274	0.321	0.321	0.245	1.26E-09	0.865	1.09E-09	46.88	0.442	0.067	0.375	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	5.43E-03	0.00E+00	0.00E+00	5.78E-05	6.16E-05	50

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	3.03E+02	0.10	8.33E+01	5.43E-03	4.00E+02	5.33E+166	1.86E-05	5.63E-03	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
2.8E-09	6.4E-06

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
5.08E+02	2.18E+05	5.08E+02	1.47E+06	5.08E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

SITE 3

RESIDENTIAL

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
67663	1.50E+01	Chloroform

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
			Totals must add up to value of L_{WT} (cell G28)							
11	15	110	110	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
S	1.80	0.330	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	3.98E+01	7.92E+03	2.3E-05	4.9E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	95	0.276	0.321	0.321	0.004	9.94E-08	0.998	9.92E-08	17.05	0.33	0.077	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	7,544	1.95E-03	8.38E-02	1.76E-04	1.31E-02	0.00E+00	0.00E+00	1.96E-04	1.02E-03	95

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
15	1.26E+03	0.10	8.33E+01	1.31E-02	4.00E+02	8.21E+68	5.93E-04	7.46E-01	2.3E-05	4.9E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	7.92E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
7.0E-06	1.5E-02

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
2.13E+00	1.03E+03	2.13E+00	7.92E+06	2.13E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	7.00E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	110	110	0	0	A	S	S		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
S	1.80	0.330	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

Lookup Soil Parameters | Lookup Soil Parameters | Lookup Soil Parameters

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	95	0.276	0.321	0.321	0.004	9.94E-08	0.998	9.92E-08	17.05	0.33	0.077	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	9.97E-03	0.00E+00	0.00E+00	1.45E-04	7.55E-04	95

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.52E+03	0.10	8.33E+01	9.97E-03	4.00E+02	5.28E+90	4.52E-04	6.85E-01	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
3.1E-05	1.9E-02

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
2.26E-01	3.73E+02	2.26E-01	1.47E+06	2.26E-01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	7.00E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
11	15	110	110	0	0	A	S	S		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
S	1.80	0.330	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	95	0.276	0.321	0.321	0.004	9.94E-08	0.998	9.92E-08	17.05	0.33	0.077	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	9.97E-03	0.00E+00	0.00E+00	1.45E-04	7.55E-04	95

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.52E+03	0.10	8.33E+01	9.97E-03	4.00E+02	5.28E+90	4.52E-04	6.85E-01	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
5.6E-07	1.1E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
1.24E+01	6.40E+03	1.24E+01	1.47E+06	1.24E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75014	1.00E+01	Vinyl chloride (chloroethene)

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
11	15	110	110	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
Lookup Soil Parameters				Lookup Soil Parameters				Lookup Soil Parameters			
S	1.80	0.330	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
1.06E-01	1.23E-05	2.69E-02	25	5,250	259.25	432.00	1.86E+01	8.80E+03	4.4E-06	1.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	95	0.276	0.321	0.321	0.004	9.94E-08	0.998	9.92E-08	17.05	0.33	0.077	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	4,989	1.78E-02	7.63E-01	1.76E-04	1.34E-02	0.00E+00	0.00E+00	1.90E-04	9.95E-04	95

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	7.63E+03	0.10	8.33E+01	1.34E-02	4.00E+02	4.11E+67	5.78E-04	4.41E+00	4.4E-06	1.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	8.80E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
8.0E-06	4.2E-02

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
1.25E+00	2.36E+02	1.25E+00	8.80E+06	1.25E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

INDUSTRIAL

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
67663	1.50E+01	Chloroform

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
11	15	110	110	0	0	A	S	S		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.80	0.330	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	3.98E+01	7.92E+03	2.3E-05	4.9E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	95	0.276	0.321	0.321	0.004	9.94E-08	0.998	9.92E-08	17.05	0.33	0.077	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	7,544	1.95E-03	8.38E-02	1.76E-04	1.31E-02	0.00E+00	0.00E+00	1.96E-04	1.02E-03	95

Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
15	1.26E+03	0.10	8.33E+01	1.31E-02	4.00E+02	8.21E+68	1.45E-04	1.83E-01	2.3E-05	4.9E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	7.92E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.0E-06	2.6E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
1.46E+01	5.87E+03	1.46E+01	7.92E+06	1.46E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	7.00E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	110	110	0	0	A	S	S		

Totals must add up to value of L_{WT} (cell G28) (applies to Thickness of soil stratum A, B, C)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
S	1.80	0.330	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	95	0.276	0.321	0.321	0.004	9.94E-08	0.998	9.92E-08	17.05	0.33	0.077	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	9.97E-03	0.00E+00	0.00E+00	1.45E-04	7.55E-04	95

Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
15	1.52E+03	0.10	8.33E+01	9.97E-03	4.00E+02	5.28E+90	1.11E-04	1.68E-01	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
4.5E-06	3.3E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
1.55E+00	2.13E+03	1.55E+00	1.47E+06	1.55E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	7.00E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	110	110	0	0	A	S	S		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
S	1.80	0.330	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	95	0.276	0.321	0.321	0.004	9.94E-08	0.998	9.92E-08	17.05	0.33	0.077	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	9.97E-03	0.00E+00	0.00E+00	1.45E-04	7.55E-04	95

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.52E+03	0.10	8.33E+01	9.97E-03	4.00E+02	5.28E+90	1.11E-04	1.68E-01	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
8.2E-08	1.9E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
8.53E+01	3.66E+04	8.53E+01	1.47E+06	8.53E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
75014	1.00E+01	Vinyl chloride (chloroethene)

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	110	110	0	0	A	S	S		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
S	1.80	0.330	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
1.06E-01	1.23E-05	2.69E-02	25	5,250	259.25	432.00	1.86E+01	8.80E+03	4.4E-06	1.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	95	0.276	0.321	0.321	0.004	9.94E-08	0.998	9.92E-08	17.05	0.33	0.077	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	4,989	1.78E-02	7.63E-01	1.76E-04	1.34E-02	0.00E+00	0.00E+00	1.90E-04	9.95E-04	95

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	7.63E+03	0.10	8.33E+01	1.34E-02	4.00E+02	4.11E+67	1.42E-04	1.08E+00	4.4E-06	1.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	8.80E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.2E-06	7.4E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
8.60E+00	1.35E+03	8.60E+00	8.80E+06	8.60E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

SITE 7

RESIDENTIAL

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
79016	1.00E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	150	150	0	0	A	LS	LS		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
LS	1.60	0.370	0.076	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm³/cm³)	Stratum B soil air-filled porosity, θ_a^B (cm³/cm³)	Stratum C soil air-filled porosity, θ_a^C (cm³/cm³)	Stratum A effective total fluid saturation, S_{te} (cm³/cm³)	Stratum A soil intrinsic permeability, k_i (cm²)	Stratum A soil relative air permeability, k_{rg} (cm²)	Stratum A soil effective vapor permeability, k_v (cm²)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm³/cm³)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	135	0.294	0.321	0.321	0.084	1.63E-08	0.955	1.55E-08	18.75	0.37	0.067	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm³/s)	Area of enclosed space below grade, A_B (cm²)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m³/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm²/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm²/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm²/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm²/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm²/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	9.79E-03	0.00E+00	0.00E+00	7.83E-05	5.37E-04	135

Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm³/s)	Crack effective diffusion coefficient, D^{crack} (cm²/s)	Area of crack, A_{crack} (cm²)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m³)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m³)
15	2.17E+02	0.10	8.33E+01	9.79E-03	4.00E+02	2.57E+92	2.37E-04	5.13E-02	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
2.3E-06	1.4E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
4.31E-01	7.11E+02	4.31E-01	1.47E+06	4.31E-01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	1.00E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	150	150	0	0	A	LS	LS		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
LS	1.60	0.370	0.076	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	135	0.294	0.321	0.321	0.084	1.63E-08	0.955	1.55E-08	18.75	0.37	0.067	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	9.79E-03	0.00E+00	0.00E+00	7.83E-05	5.37E-04	135

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.17E+02	0.10	8.33E+01	9.79E-03	4.00E+02	2.57E+92	2.37E-04	5.13E-02	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
4.2E-08	8.2E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
2.37E+01	1.22E+04	2.37E+01	1.47E+06	2.37E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

INDUSTRIAL

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	1.00E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	150	150	0	0	A	LS	LS		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
Lookup Soil Parameters				Lookup Soil Parameters				Lookup Soil Parameters			
LS	1.60	0.370	0.076	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	135	0.294	0.321	0.321	0.084	1.63E-08	0.955	1.55E-08	18.75	0.37	0.067	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	9.79E-03	0.00E+00	0.00E+00	7.83E-05	5.37E-04	135

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.17E+02	0.10	8.33E+01	9.79E-03	4.00E+02	2.57E+92	5.81E-05	1.26E-02	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
3.4E-07	2.5E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
2.96E+00	4.06E+03	2.96E+00	1.47E+06	2.96E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
79016	1.00E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	150	150	0	0	A	LS	LS		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
LS	1.60	0.370	0.076	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	135	0.294	0.321	0.321	0.084	1.63E-08	0.955	1.55E-08	18.75	0.37	0.067	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	9.79E-03	0.00E+00	0.00E+00	7.83E-05	5.37E-04	135

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.17E+02	0.10	8.33E+01	9.79E-03	4.00E+02	2.57E+92	5.81E-05	1.26E-02	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
6.2E-09	1.4E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
1.63E+02	6.97E+04	1.63E+02	1.47E+06	1.63E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

SITE 15

RESIDENTIAL

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
67663	3.00E+00	Chloroform

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
11	15	200	200	0	0	A	LS	LS		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
LS	1.50	0.450	0.076	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	3.98E+01	7.92E+03	2.3E-05	4.9E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	185	0.374	0.321	0.321	0.067	1.63E-08	0.964	1.57E-08	18.75	0.45	0.147	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	7,544	1.95E-03	8.38E-02	1.76E-04	1.94E-02	0.00E+00	0.00E+00	8.86E-04	6.22E-03	185

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.52E+02	0.10	8.33E+01	1.94E-02	4.00E+02	3.87E+46	1.47E-03	3.71E-01	2.3E-05	4.9E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	7.92E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
3.5E-06	7.3E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
8.56E-01	4.14E+02	8.56E-01	7.92E+06	8.56E-01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

INDUSTRIAL

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
67663	3.00E+00	Chloroform

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	200	200	0	0	A	LS	LS		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
LS	1.50	0.450	0.076	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	3.98E+01	7.92E+03	2.3E-05	4.9E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	185	0.374	0.321	0.321	0.067	1.63E-08	0.964	1.57E-08	18.75	0.45	0.147	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	7,544	1.95E-03	8.38E-02	1.76E-04	1.94E-02	0.00E+00	0.00E+00	8.86E-04	6.22E-03	185

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.52E+02	0.10	8.33E+01	1.94E-02	4.00E+02	3.87E+46	3.61E-04	9.08E-02	2.3E-05	4.9E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	7.92E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
5.1E-07	1.3E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
5.87E+00	2.36E+03	5.87E+00	7.92E+06	5.87E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

SITE 20

RESIDENTIAL

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	5.02E+00	Trichloroethylene

MORE ↓

Totals must add up to value of L_{WT} (cell G28)

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
11	15	140	140	0	0	A	SL	SL		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SL	1.60	0.370	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm³/cm³)	Stratum B soil air-filled porosity, θ_a^B (cm³/cm³)	Stratum C soil air-filled porosity, θ_a^C (cm³/cm³)	Stratum A effective total fluid saturation, S_{te} (cm³/cm³)	Stratum A soil intrinsic permeability, k_i (cm²)	Stratum A soil relative air permeability, k_{rg} (cm²)	Stratum A soil effective vapor permeability, k_v (cm²)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm³/cm³)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	125	0.267	0.321	0.321	0.193	5.94E-09	0.895	5.32E-09	25.00	0.37	0.050	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm³/s)	Area of enclosed space below grade, A_B (cm²)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m³/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm²/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm²/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm²/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm²/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm²/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	7.10E-03	0.00E+00	0.00E+00	3.42E-05	1.68E-04	125

Convection path length, L_p (cm)	Source vapor conc., C_{source} (µg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm³/s)	Crack effective diffusion coefficient, D^{crack} (cm²/s)	Area of crack, A_{crack} (cm²)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m³)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m³)
15	1.09E+03	0.10	8.33E+01	7.10E-03	4.00E+02	2.28E+127	8.26E-05	8.98E-02	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
4.1E-06	2.5E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
1.24E+00	2.04E+03	1.24E+00	1.47E+06	1.24E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	5.02E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
			Totals must add up to value of L_{WT} (cell G28)							
11	15	140	140	0	0	A	SL	SL		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SL	1.60	0.370	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm³/cm³)	Stratum B soil air-filled porosity, θ_a^B (cm³/cm³)	Stratum C soil air-filled porosity, θ_a^C (cm³/cm³)	Stratum A effective total fluid saturation, S_{te} (cm³/cm³)	Stratum A soil intrinsic permeability, k_i (cm²)	Stratum A soil relative air permeability, k_{rg} (cm²)	Stratum A soil effective vapor permeability, k_v (cm²)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm³/cm³)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	125	0.267	0.321	0.321	0.193	5.94E-09	0.895	5.32E-09	25.00	0.37	0.050	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm³/s)	Area of enclosed space below grade, A_B (cm²)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m³/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm²/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm²/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm²/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm²/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm²/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	7.10E-03	0.00E+00	0.00E+00	3.42E-05	1.68E-04	125

Convection path length, L_p (cm)	Source vapor conc., C_{source} (µg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm³/s)	Crack effective diffusion coefficient, D^{crack} (cm²/s)	Area of crack, A_{crack} (cm²)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m³)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m³)
15	1.09E+03	0.10	8.33E+01	7.10E-03	4.00E+02	2.28E+127	8.26E-05	8.98E-02	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
7.4E-08	1.4E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
6.80E+01	3.50E+04	6.80E+01	1.47E+06	6.80E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

INDUSTRIAL

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
79016	5.02E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
			Totals must add up to value of L_{WT} (cell G28)							
11	15	140	140	0	0	A	SL	SL		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SL	1.60	0.370	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	125	0.267	0.321	0.321	0.193	5.94E-09	0.895	5.32E-09	25.00	0.37	0.050	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	7.10E-03	0.00E+00	0.00E+00	3.42E-05	1.68E-04	125

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.09E+03	0.10	8.33E+01	7.10E-03	4.00E+02	2.28E+127	2.02E-05	2.20E-02	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
5.9E-07	4.3E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
8.48E+00	1.17E+04	8.48E+00	1.47E+06	8.48E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	5.02E+00	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
11	15	140	140	0	0	A	SL	SL		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SL	1.60	0.370	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	125	0.267	0.321	0.321	0.193	5.94E-09	0.895	5.32E-09	25.00	0.37	0.050	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	7.10E-03	0.00E+00	0.00E+00	3.42E-05	1.68E-04	125

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.09E+03	0.10	8.33E+01	7.10E-03	4.00E+02	2.28E+127	2.02E-05	2.20E-02	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.1E-08	2.5E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
4.67E+02	2.00E+05	4.67E+02	1.47E+06	4.67E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

SITE 23

RESIDENTIAL

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
67663	3.00E+00	Chloroform

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
			Totals must add up to value of L_{WT} (cell G28)							
11	15	210	210	0	0	A	SL	SL		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SL	1.50	0.450	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	3.98E+01	7.92E+03	2.3E-05	4.9E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	195	0.347	0.321	0.321	0.156	5.94E-09	0.917	5.45E-09	25.00	0.45	0.130	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	7,544	1.95E-03	8.38E-02	1.76E-04	1.51E-02	0.00E+00	0.00E+00	5.93E-04	3.65E-03	195

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
15	2.52E+02	0.10	8.33E+01	1.51E-02	4.00E+02	6.17E+59	9.46E-04	2.38E-01	2.3E-05	4.9E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	7.92E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
2.2E-06	4.7E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
1.33E+00	6.44E+02	1.33E+00	7.92E+06	1.33E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: *The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.*

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	5.00E-01	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
11	15	210	210	0	0	A	SL	SL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SL	1.50	0.450	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	195	0.347	0.321	0.321	0.156	5.94E-09	0.917	5.45E-09	25.00	0.45	0.130	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	1.15E-02	0.00E+00	0.00E+00	4.45E-04	2.75E-03	195

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.08E+02	0.10	8.33E+01	1.15E-02	4.00E+02	5.15E+78	7.47E-04	8.09E-02	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
3.7E-06	2.2E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
1.37E-01	2.26E+02	1.37E-01	1.47E+06	1.37E-01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	5.00E-01	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	210	210	0	0	A	SL	SL		

(Thickness columns: Totals must add up to value of L_{WT} (cell G28))

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SL	1.50	0.450	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	195	0.347	0.321	0.321	0.156	5.94E-09	0.917	5.45E-09	25.00	0.45	0.130	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	1.15E-02	0.00E+00	0.00E+00	4.45E-04	2.75E-03	195

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.08E+02	0.10	8.33E+01	1.15E-02	4.00E+02	5.15E+78	7.47E-04	8.09E-02	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
6.6E-08	1.3E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
7.52E+00	3.87E+03	7.52E+00	1.47E+06	7.52E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

INDUSTRIAL

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
67663	3.00E+00	Chloroform

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	210	210	0	0	A	SL	SL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
Lookup Soil Parameters				Lookup Soil Parameters				Lookup Soil Parameters			
SL	1.50	0.450	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	3.98E+01	7.92E+03	2.3E-05	4.9E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm³/cm³)	Stratum B soil air-filled porosity, θ_a^B (cm³/cm³)	Stratum C soil air-filled porosity, θ_a^C (cm³/cm³)	Stratum A effective total fluid saturation, S_{te} (cm³/cm³)	Stratum A soil intrinsic permeability, k_i (cm²)	Stratum A soil relative air permeability, k_{rg} (cm²)	Stratum A soil effective vapor permeability, k_v (cm²)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm³/cm³)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	195	0.347	0.321	0.321	0.156	5.94E-09	0.917	5.45E-09	25.00	0.45	0.130	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm³/s)	Area of enclosed space below grade, A_B (cm²)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m³/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm²/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm²/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm²/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm²/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm²/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	7,544	1.95E-03	8.38E-02	1.76E-04	1.51E-02	0.00E+00	0.00E+00	5.93E-04	3.65E-03	195

Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm³/s)	Crack effective diffusion coefficient, D^{crack} (cm²/s)	Area of crack, A_{crack} (cm²)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m³)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m³)
15	2.52E+02	0.10	8.33E+01	1.51E-02	4.00E+02	6.17E+59	2.32E-04	5.83E-02	2.3E-05	4.9E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	7.92E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
3.3E-07	8.1E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
9.15E+00	3.68E+03	9.15E+00	7.92E+06	9.15E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	5.00E-01	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
11	15	210	210	0	0	A	SL	SL		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SL	1.50	0.450	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	3.5E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	195	0.347	0.321	0.321	0.156	5.94E-09	0.917	5.45E-09	25.00	0.45	0.130	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	1.15E-02	0.00E+00	0.00E+00	4.45E-04	2.75E-03	195

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.08E+02	0.10	8.33E+01	1.15E-02	4.00E+02	5.15E+78	1.83E-04	1.98E-02	1.1E-04	3.5E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
5.3E-07	3.9E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
9.38E-01	1.29E+03	9.38E-01	1.47E+06	9.38E-01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	5.00E-01	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
11	15	210	210	0	0	A	SL	SL		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SL	1.50	0.450	0.103	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	195	0.347	0.321	0.321	0.156	5.94E-09	0.917	5.45E-09	25.00	0.45	0.130	0.320	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,544	5.05E-03	2.17E-01	1.76E-04	1.15E-02	0.00E+00	0.00E+00	4.45E-04	2.75E-03	195

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.08E+02	0.10	8.33E+01	1.15E-02	4.00E+02	5.15E+78	1.83E-04	1.98E-02	2.0E-06	6.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
9.7E-09	2.3E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

PRG SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (mg/L)	Indoor exposure groundwater conc., noncarcinogen (mg/L)	Risk-based indoor exposure groundwater conc., (mg/L)	Pure component water solubility, S (mg/L)	Final indoor exposure groundwater conc., (mg/L)
5.16E+01	2.21E+04	5.16E+01	1.47E+06	5.16E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END